# JOURNAL OF ELECTRICITY

## POWER AND GAS

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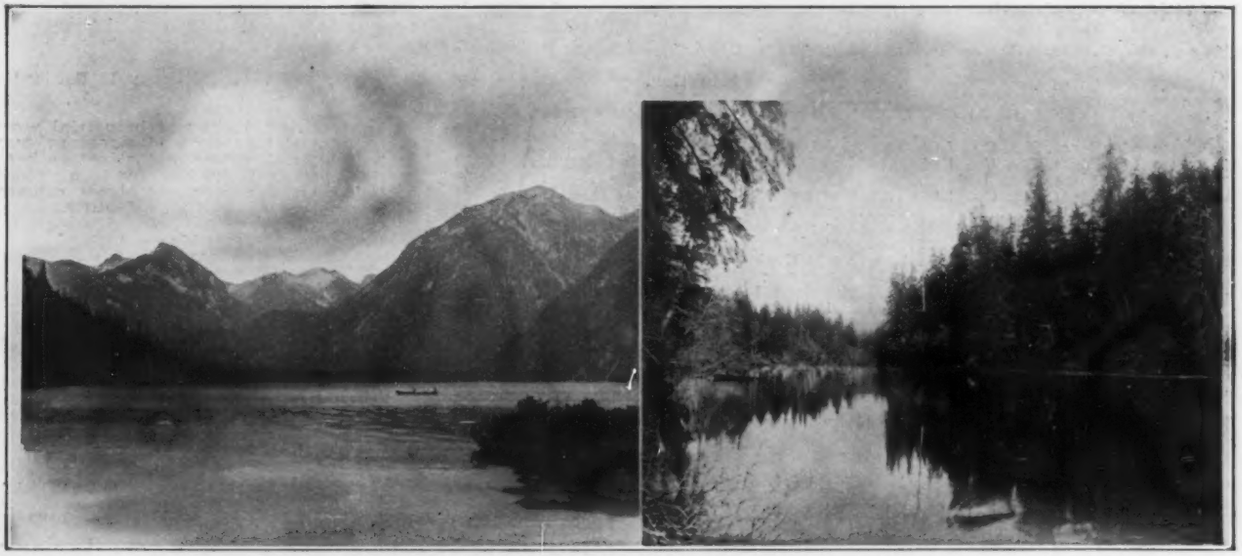


Natural Reservoirs for British Columbia Power Supply.

# BRITISH COLUMBIA HYDROELECTRIC DEVELOPMENTS

*(Brief description is here given of the various waterpower plants of British Columbia. The text has been condensed from a report by G. R. G. Conway prepared for the water power branch of the Canadian Department of the Interior.—The Editor.)*

The Province of British Columbia has a superficial area of 372,640 square miles, and within its boundaries there are vast undeveloped resources of mineral and timber wealth. The value of these great resources of wealth is enormously increased by long Pacicfic coast line with its numerous excellent harbors, with the great navigable rivers and lakes, great railway systems, and by numerous water powers that are capable of development for the transmission of electrical energy over practically the whole of the mining, industrial and populated areas of the Province.

One of the most remarkable features of the coast are the fiords and passages which are analagous to those of Scotland and Norway, and probably surpass those of any part of the world in dimensions and complexity, with perhaps the exception of those in Greenland. The great height of the rugged mountain walls which border them also gives them a grandeur quite their own. The unique position of British Columbia as a watershed on the Pacific coast of America will be at once recognized when it is understood that all the rivers of great importance on that coast, with the exception of one, the Colorado, rise from within its boundaries. The drainage from its extensive area of mountains and highlands is received into the numerous lakes, thence the surplus is discharged into the few large rivers or their tributaries which finally reach the sea. The principal of these rivers are the Columbia on the south which flows through American territory into the Pacific Ocean, the Fraser River, 750 miles long, the Skeena, 300 miles long, and the Stikine on the west, the Liard, over 300 miles in British Columbia on the north, and the Peace River, over 300 miles in British Columbia, on the east. These rivers are of great size and volume and the first four are sufficiently navigable to steamers to form water ways of no small value in the development of the Province.

The area occupied by the principal lakes of the Province amounts to 2439 square miles.

The submerged mountain range which lies to the west of the mainland is represented by an archipelago of islands, the most prominent being Vancouver and the Queen Charlotte Islands. Of the others, it may be briefly stated that they produce in miniature all the physical features of the larger group.

The development of hydroelectric plants on a fairly large scale began in British Columbia as early as 1897. The first plants of any magnitude were those

at Bonnington Falls on the Kootenay River near Nelson, B. C., and the Goldstream plant of the British Columbia Electric Railway on Vancouver Island. These plans were under construction simultaneously, but the Bonnington Falls plant can claim priority as it was placed in operation early in 1898, while the Goldstream plant was first operated in September of the same year. Since that date large plants have been installed for the production of electrical energy for the cities of Victoria and Vancouver, and for the manufacture of pulp, and in the mining industry. The following is a list of some of the principal developed water powers which will be described in detail later:

Within reasonable distance of Vancouver and Victoria there are possibilities of the economic development of water powers aggregating 750,00 h.p. These water powers are all situated within an area of 20,000 square miles, thus representing 37½ h.p. for each square mile of territory. Outside of this area a rough estimate of the water power possibilities of the Province would bring this figure up to 3,000,000 h.p., or nearly equal to the estimate, and in the writer's opinion this amount is conservative, although until much further investigations have been made, such an estimate is an intelligent guess.

The capitalist and manufacturer seeking for opportunities of developing new industries, will find a fertile field in British Columbia for utilizing these water powers in addition to their use in supplying electrical energy for cities and towns. Already large Portland cement plants using about 8000 h.p. of electrical energy are in operation on Vancouver Island, paper pulp is being manufactured on a large scale, and smelting plants are being operated by water powers.

In British Columbia, there are in many of the water powers somewhat similar conditions to those that obtain in Scandinavian territory, i.e., powers that can be developed economically under high heads. In the writer's opinion, excluding the cost of transmission lines, many of these including some low head plants, can be developed as complete installations from $60 to $100 per horsepower, and those powers nearer the lower figure make them as economical possibility for successfully undertaking electro-chemical industries. Considering this fact together with the wonderful possibilities of transport by water freight to the markets, the advantages in competing with less favorable districts is obvious.

The following descriptions will indicate to what extent the waterpower resources of the Province have already been developed, and will give the reader some idea of their application at the present time.

est and most important development in the interior of British Columbia, and furnish power and light to the cities of Trail, Rossland, Grand Forks, Phoenix, Greenwood, Boundary Falls and other municipalities within

**Capacity of the Principal Water Powers as at Present Developed in the Province of British Columbia.**

| Owner. | Situation. | Present capacity installed horsepower. | Purpose for Which Energy Is Utilized. |
|---|---|---|---|
| West Kootenay Power & Light Co., Ltd.. | Kootenay River and Kettle River, near Nelson | 23,000 | Mining, smelting, light and industrial power. |
| British Columbia Elect. Ry. Co., Ltd. | Goldstream, near Victoria | 3,000 | Light, industrial power and street railways. |
| British Columbia Elect. Ry. Co., Ltd. | Lake Buntzen, Burrard Inlet | 84,500 | Light, industrial power and street railways. |
| Western Canada Power Co., Ltd. | Stave Lake, near Ruskin | 26,000 | Industrial power (26,000 h.p. now being added). |
| British Columbia Elect. Ry. Co., Ltd. | Jordan River, Vancouver Island.. | 25,000 | Light, industrial power and street railways. |
| Ocean Falls Co., Ltd. | Link River, Ocean Falls | 11,200 | Wood pulp and lumber manufacture. |
| Canadian Collieries (Dunsmuir), Ltd. | Puntledge River, near Nanaimo.. | 9,400 | Coal mining. |
| Powell River Co., Ltd. | Powell River | 24,000 | News print paper manufacture. |
| Granby Consolidated M., S. & P. Co., Ltd.. | Falls Creek, Granby Bay | 7,325 | Copper mining and smelting. |
| City of Nelson | Kootenay River, near Nelson | 4,000 | Mining, industrial power and light. |
| City of Kamloops | Barriere River, near Nelson | 2,800 | Light and industrial power. |
| Britannia Mining & Smelting Co., Ltd. | Britannia Creek, Howe Sound | 2,735 | Copper mining and reduction. |
| Hedley Gold Mining Company | Similkameen River, near Hedley | 2,650 | Gold mining. |
| City of Prince Rupert | Woodworth Lake, nr. P. Rupert. | 1,650 | Light and industrial power. |
| Swanson Bay F., W. P. & Lbr. Mills, Ltd.. | Swanson Bay | 1,250 | Wood pulp and lumber manufacture. |
| City of Revelstoke | Illecillwaet River, nr. Revelstoke | 600 | Light and industrial power. |
| Other small developments | | 890 | Mining, municipal and hotel lighting, salmon canning. |
| | Total horsepower at present installed | 230,000 | |

## West Kootenay Power & Light Co., Ltd.

The West Kootenay Power & Light Company, Ltd., owns and operates three hydroelectric generating plants on the Kootenay and Kettle Rivers, having an aggregate capacity of 23,000 h.p.. These are the largthe radius of their transmission lines. In this section of British Columbia the mines and smelters are the lowest consumers of power.

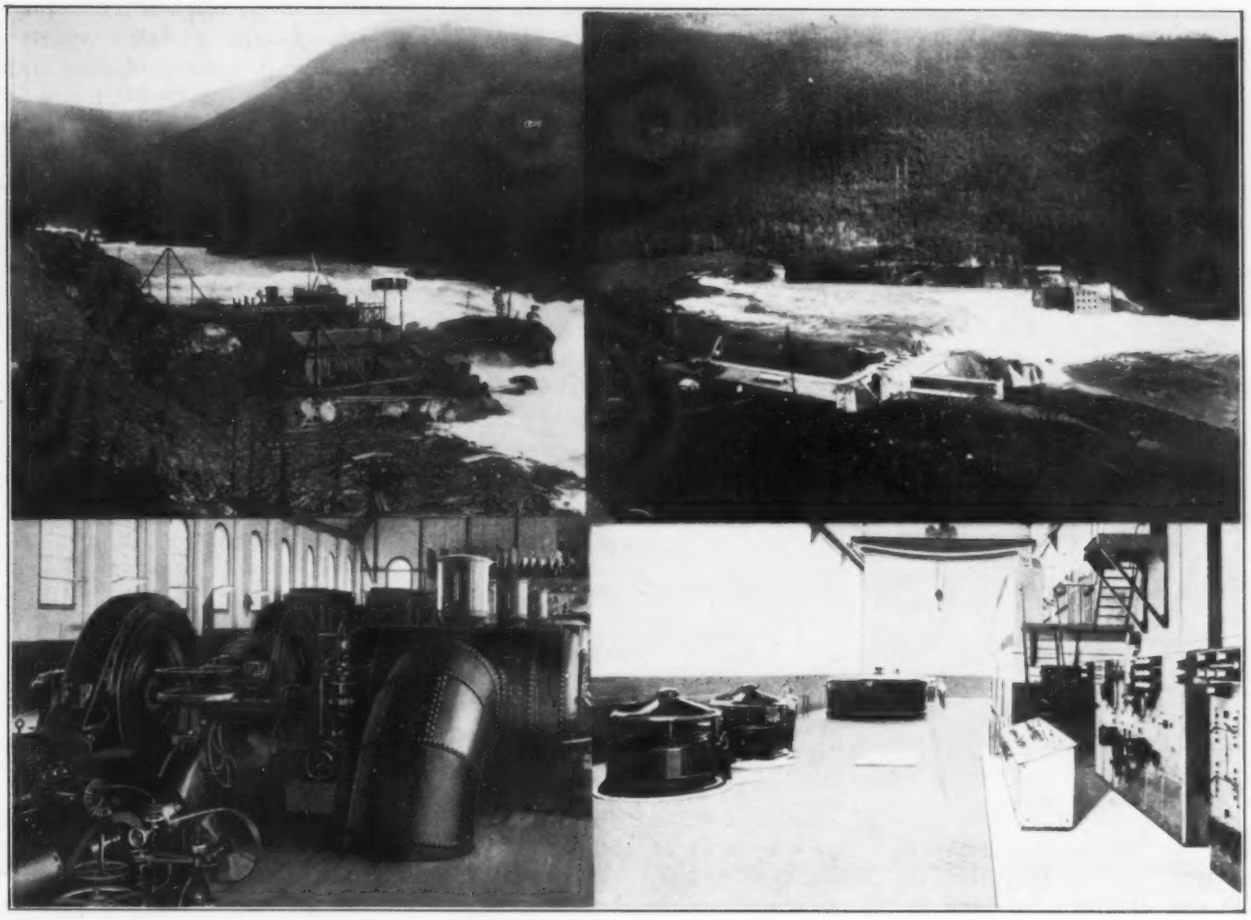
The Kootenay River plants are at Bonnington Falls about 11 miles below the city of Nelson, where the minimum flow at Bonnington Falls is 5850 cu. ft. per sec., and occurs during the months of January and February. The maximum flow of 60,000 cu. ft. per sec. occurs during June and July, when the snow is melting most rapidly.

Space is provided in Plant No. 1 for four main generating units, two exciter units, and for all transformer and switching apparatus to complete the plant. At present, two units are installed. A 30-ton electrically operated overhead travelling crane spans the main generator room, and railroad cars can be brought into the power house on a spur track under the crane.

From Plant No. 1 current is transmitted at 22,000 volts to Rossland, Trail, Nelson and Silver King Mine, where substations are provided. The longest distance over which current at this voltage is transmitted is 32 miles. From Plant No. 2, current

**West Kootenay Power & Light Co., Ltd., Hydraulic Plant Equipment.**

| | Turbines. | Generators. | Transformers. |
|---|---|---|---|
| Bonnington Falls No. 1..... | 1-2000 h.p. Victor. | 1100 volts. | 4 banks, air blast 1100/22000 v. |
| | 2-1000 h.p. Victor. | Canadian General Electric. | 750 kw. Can. Gen. Elec. |
| Bonnington Falls No. 2..... | 2-8000 h.p. Francis. | 2-5625 kw. C. G. E. | 3 banks of 3-1875 kw. oil insulated water cooled 2200/60,000. |
| | | | 1 bank 3-1250 kw., 2200/22000. |
| Kettle River ..... | 3-1300 h.p. | 3-750 kw. | 3 banks of 3-312 kw., 2200/22000 |



Bonnington Falls Developments.

at 60,000 volts is transmitted a distance of 81 miles to Greenwood Substation, and to substations at Rossland, Grand Forks, Phoenix and Boundary Falls Substation, which is 84 miles from Bonnington Falls.

The Kettle River Plant, known as No. 3 Plant or Cascade Plant of the West Kootenay Power and Light Company, is located on the Kettle River in the "Boundary District," about 12 miles below the town of Grand Forks.

The generating equipment of No. 3 Plant consists of three units. Current is transmitted at 22,000 volts to substations at Grand Forks, Phoenix, Greenwood and Boundary Falls, the latter substation being 28 miles distant from No. 3 plant.

**British Columbia Electric Railway Company.**

In 1898 the Goldstream power house, 12 miles from Victoria, was built by the B. C. Electric Railway Company, Ltd. The power house is of brick on concrete foundations, and is situated near the west bank of the lower reservoir, the available static head at the water wheels being 650 ft.

Current is generated at 700 volts, and by means of air cooled transformers it is stepped up to 17,500 volts, at which it is transmitted over a two circuit single pole transmission line to Victoria, twelve miles distant, where it is received at Rock Bay substation alng with energy from the Vancouver Island Power Company's plants at Jordan River and Brentwood Bay.

Coquitlam Lake is the main storage reservoir for two large plants supplying Vancouver and environs, the natural catchment being augmented by a hydraulic fill dam, 1200 ft. long, 655 ft. wide at the base and 100 ft. high. This gives a storage capacity of 180,500 acre feet available for power purposes. New Westminster also obtains its water supply from this source.

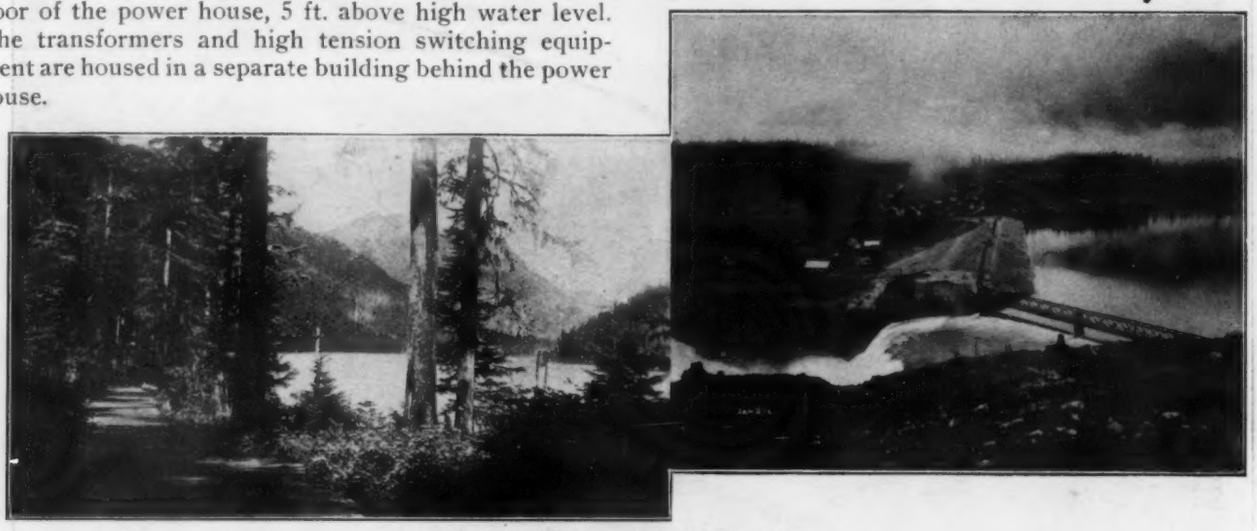
Water is conveyed from Lake Coquitlam to Lake Buntzen, the forebay, through a 12,650 ft. tunnel with 192 sq. ft. section, the two lakes being separated by a range of mountains 4000 ft. high. A concrete dam, 54 ft. high and 361 ft. crest at the lower end of the lake gives a 400 ft. head. Ten 54 in. and two 24 in. outlets with trash racks and head gates are provided for the pipe lines which convey water to power house No. 1.

**British Columbia Electric Railway Co., Ltd., Hydraulic Plant Equipment.**

| | Turbines. | Generators. | Transformers. |
|---|---|---|---|
| Goldstream | 2-600 h.p. Pelton.<br>2-1000 h.p. Pelton. | 2-350 kw., 1-500 kw.<br>1-1000 kw. | 700/17500 air blast. |
| Lake Buntzen No. 1 | 4-3000 h.p. Pelton. | 4-1500 kw. Westinghouse. | 3 banks of 3-3000 k.w., 2200/84600. |
| | 1-10500 h.p. Pelton.<br>2-10500 h.p. Doble | 2-5000 kw. C. G. E.<br>1-5000 kw. Dick Kerr. | |
| Lake Buntzen No. 2 | 3 units of 4 Pelton-Doble wheels, 13,500 h.p. | 3-8900 k.v.a. Dick Kerr 2200 volts. | 4 banks of 3-3000 kw., 2200/34000. |
| Jordan River | 2-6000 h.p. Doble. | 2-400 k.v.a. Allis-Chalmers Bullock, 2200 volts. | 2 banks of 3-1450 k.v.a.<br>1 bank of 3-3000 k.v.a. 2200/60000 Canadian Westinghouse. |
| | 2-6500 h.p. Pelton-Doble. | 1-8000 k.v.a. C. G. E., 2200 v. | |

Lake Buntzen Power House No. 1 is situated on the east shore of Burrard Inlet about 16 miles from the City of Vancouver. The power house is built of hewn granite, the main floor being 5 ft. above high water. The original installation has been added to from time to time, and the present equipment having a capacity of 16,500 kw.

The generating equipment is installed on the main floor of the power house, 5 ft. above high water level. The transformers and high tension switching equipment are housed in a separate building behind the power house.

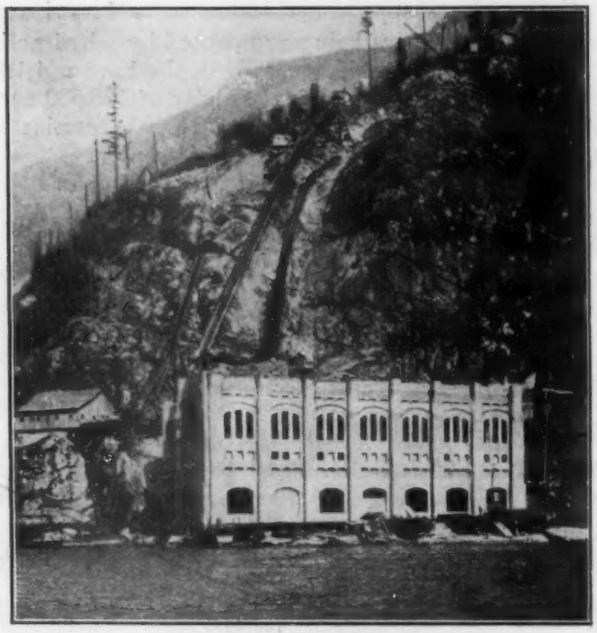


Lake Coquitlam and Coquitlam Dam.

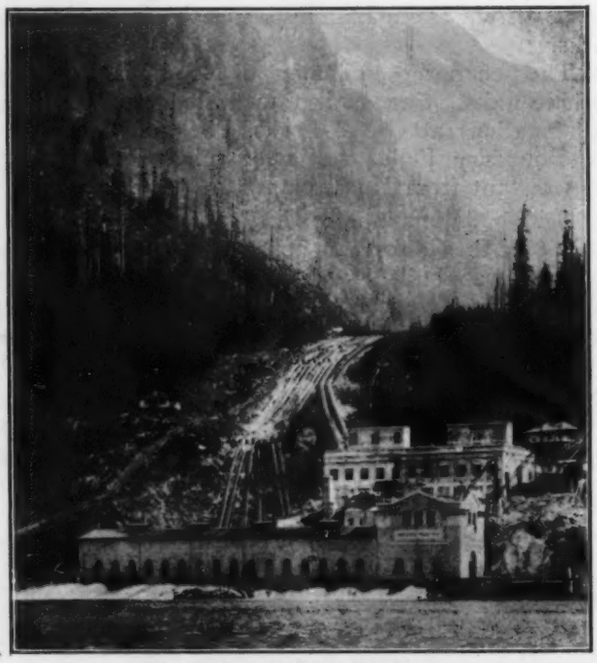
Each of the 1500 kw. units is supplied with water from Lake Buntzen by means of a pipe line 48 in. in diameter and 2000 ft. in length. Two pipe lines 60 in. in diameter are provided for the fifth unit. One pipe line 84 in. in diameter at the upper end and tapering to 72 in. in diameter at the power house, is provided for the sixth unit, and a similar pipe line provides water for No. 7 unit. In the original installation the first 800 ft. of the pipe lines below Lake Buntzen Dam were of wood stave construction. The wood stave portions of these pipes have now been replaced with pipes of riveted steel.

Plant No. 2, Lake Buntzen, is situated about one-third of a mile to the south of the original power house. It is of reinforced concrete and contains wheels of a total capacity of 40,500 h.p. generators and transformers, together with the necessary high and low tension switching equipment. Water for driving the units is obtained from Lake Buntzen through a concrete lined pressure tunnel 14 ft. 8 in. internal diameter and about 1800 ft. long, driven through solid rock and controlled by three Doble needle intake valves placed with their seats on a concrete foundation on the bottom of Lake Buntzen. An outer cylinder is provided which may be lowered down to a horizontal seat, thus excluding water from the needle valves so that they may be inspected without the use of a diver. These needle valves are operated by means of oil pressure.

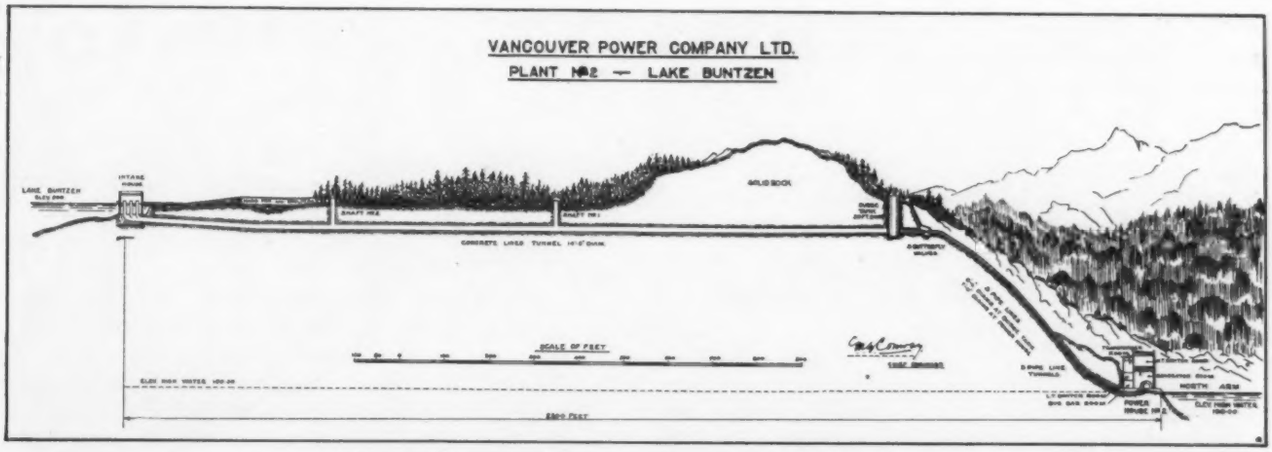
Near the lower end of the pressure tunnel and close to the top of the hill, a steel surge tank 30 ft. in diameter is provided, and from this point the water is conducted to Power House No. 2 through three



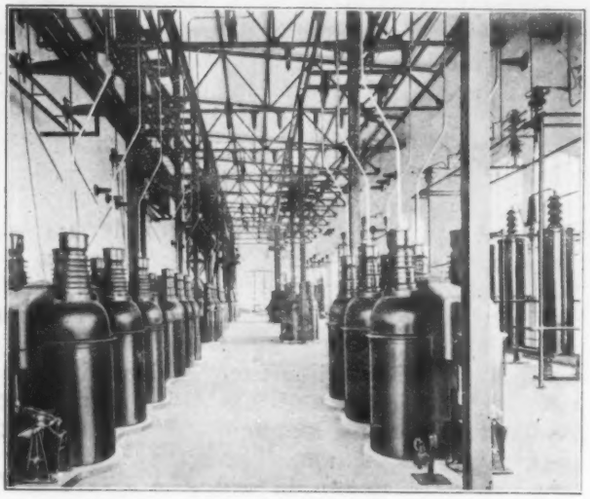
Plant No. 1, Lake Buntzen.



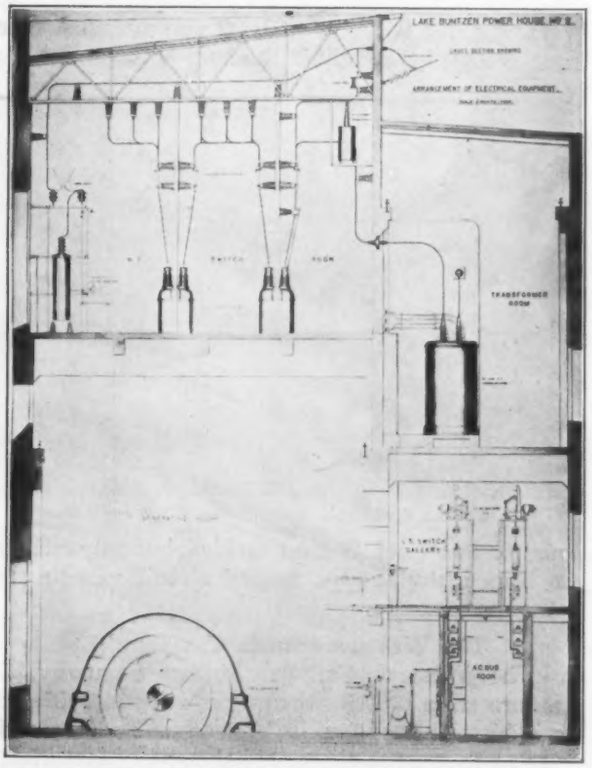
Plant No. 2, Lake Buntzen.




Cross Section of Plant No. 2, Development, Lake Buntzen.



High Tension Switch Room at Buntzen Plant No. 2.




Arrangement of Electrical Equipment at Lake Buntzen Plant No. 2.

steel pipe lines. Close to the surge tank a Pelton Doble Venturi butterfly valve is installed in each pipe line. The pipe lines are connected to the surge tank by means of flanged reinforcing plates. The pipe lines are 8 ft. 6 in. in diameter and ½ in. thick at their upper ends, tapering to a diameter of 7 ft. at the power house, where the thickness is 1⅛ in. About 200 ft. from the power house the pipe lines pass into tunnels driven through rock. The pipe line grades are steep, the slopes ranging from 28 to 53 degrees, thus rendering difficult the handling of the large pipe sections.

The bus bars are placed in cells in the bus bar room at the level of the main floor, and the voltage is controlled by Tirrill regulators. The low tension generator and transformer switches, which are of the Canadian General Electric H-6 type, are placed in the low tension switchroom situated above the bus bar compartments. The transformer room is situated immediately above the low tension switchroom. The high tension switchroom, which also contains the lightning arrestor equipment, is situated above the generator room; the high tension switches are of the Canadian General Electric K-15 type. All of the low tension and high tension switches are electrically controlled from the operating benchboard which is situated on the operating gallery in the generator room. All of the switches, switchboard equipment, and transformers were supplied by the Canadian General Electric Company. Two 50-ton electrically operated travelling cranes control the entire length of the generator room, and one 25-ton electric crane is provided in the transformer room.

The electrical energy at Lake Buntzen is transmitted at 34,600 volts to substations at Vancouver and to other substations in the territory served by the company, by two 2-circuit transmission lines. Two of these circuits, which are connected in at Plant No. 1, are carried on wooden poles; the other two circuits are outgoing lines from Plant No. 2 and are carried on steel towers. A tie line connects Power Houses Nos. 1 and 2.

**The Jordan River plant** of the Vancouver Island Power Company, Limited, a company subsidiary to the British Columbia Electric Railway Company, Limited, is situated at the mouth of Jordan River, which flows into the Straits of San Juan de Fuca about 40 miles

west of the City of Victoria, Vancouver Island, the main floor being 7 ft. 6 in. above high tide level. Water is conveyed to the water wheels in the power house from a forebay reservoir through steel pipe lines 9290 ft. long. The forebay, which is a small equalizing reservoir formed by two earth fill dams, is about 1152 ft. above sea level, giving a static head of 1145 ft. at the nozzles in the power house. Water is carried from

The Jordan River Dam.

the diversion point on the Jordan River to the forebay reservoir in a wooden flume about 5½ miles long, built along the east side of the Jordan River Valley. A small dam in Alligator Creek diverts the water from that creek into a small flume which joins the main flume about a mile below the diversion point on Jordan River. Wye Creek joins the river above the diversion dam. Bear Creek flows into the Jordan River about 3½ miles above the main diversion dam, and the Bear Creek storage dam lies near the headwaters of that creek and about a mile above its junction with the Jordan River.

On account of the variable flow of the Jordan River and its tributaries, storage reservoirs form an essential part of the scheme. Five sites suitable for storage dams have been located, but only two of these dams have been constructed at the present time. These dams are known as Bear Creek dam and Jordan River dam.

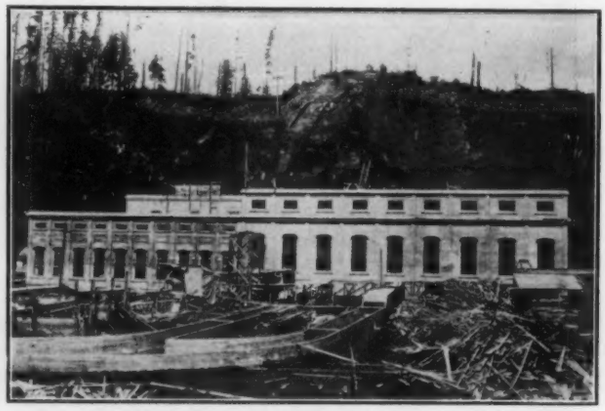
The Jordan River dam is a hollow reinforced concrete structure of the Ambursen type, with crest 1268 ft. above sea level. The dam is 891 ft. in length along the crest. A spillway is provided near the east end of the dam with curved crest and rollway apron which enables water overflowing the spillway to fall clear of the toe of the buttresses; the spillway is 305 ft. long with the crest 8 ft. below the top of the dam and provides for a discharge of 23,000 cu. ft. per second. The extreme height of the dam is 126 ft. above the lowest point of the foundation on the centre line. This dam is believed to be the highest dam in Canada, and it is the second highest dam of the Ambursen type so far constructed.

The original power house building completed in 1911 was a concrete structure, in which two units of 4000 kw. capacity were installed with the necessary exciters, low and high tension switches and transformers. On account of the rapidly increasing load on the company's system, the original installation has been added to. The additions necessitated the extension of the power house building to accommodate a new 8000 kw. unit with space for a fourth unit, and an entirely new high tension switchroom for the completed plant behind the power house. The extensions were com-- pleted in October, 1914.

The low tension generator and transformer switches are placed on the main floor at the west end of the new portion of the building; these switches are of the H-6 type of the Canadian General Electric Company. The bus bars are carried in concrete cells in the basement, immediately under the low tension switches.

Current at 60,000 volts is conducted from the transformers through the back wall of the generator room in porcelain wall bushings into the high tension switch room. The high tension buses are supported in insulators on the back wall of the room, and the 60,-000 volt type A. A. Westinghouse switches are in a line down the center of the room, directly under the disconnecting switches, which are mounted on a structural steel frame. All high tension conductors are of 1 in. copper tubing. Two 60,000 volt lines leave the building through large wall bushings and lead to a steel distributing tower a short distance in the rear of the power house.

The transmission line from Jordan River power house to Victoria Substation is about 37 miles long. For about 15 miles the location follows the shore, then strikes inland to Victoria. The poles are of cedar cut along the line; they vary in height from 50 ft. to 60 ft. and have a minimum diameter at the top of 9 in. The conductor is aluminum cable made up of seven strands of No. 8 wire; two piece 60,000 volt suspension insulators are used throughout the length of the line. Cross



Jordan Power House During Construction.

arms for two circuits are provided, but only one circuit has been installed; the second circuit will be strung in the near future.

**The Western Canada Company, Ltd.**

The Western Canada Power Company, Ltd., was formed in 1909 for the purpose of supplying power for industrial purposes in Vancouver and the vicinity so as to encourage the establishment of factories, and in sufficient quantity to meet any demand that the growth of Vancouver may develop. They commenced

Interior of Stave Falls Plant, showing Switchboard Gallery.

Stave Falls Plant.

the construction of a 50,000 h.p. power plant in the winter of 1909-1910. The first section of this power house, comprising two units of 9000 kw. capacity each, was completed and power was delivered in Vancouver on January 1, 1912.

The site of the power development is at Stave Falls, about six miles north from the junction of the Stave and Fraser Rivers at Ruskin, B. C., and thirty-five miles east of the City of Vancouver.

The power plant, as it now stands, consists of a sluice dam 40 ft. high, provided with five sluice ways 22 ft. wide, to take care of the flood discharge; a solid concrete intake dam; two 14 ft. 6 in. steel penstocks with provision for two more; a power house with two 10,000 kw. units and provision for extension for two more, and a tailrace channel 1500 ft. long excavated in the old bed of the river. The foundations for the power house were excavated in solid rock. The total quantity of rock excavation for the penstocks, power house and tailrace amounted to 75,000 cubic yards.

The tailrace canal is 70 ft. wide, and designed to run 10 ft. deep when all four units in the power house are in operation. In addition to the rock excavation for the tailrace, some 75,000 cu. yd. of sand, clay and boulders were excavated by steam shovel.

Just below the power house a small V-shaped weir was built to hold the water to a proper height to seal the draft tubes. At present the flow of the river is rapid from below the foot of the tailrace, but when the lower plant is built, the water will be backed up to this weir.

**Western Canadian Power Co., Ltd., Hydraulic Plant Equipment.**

| | Turbines. | Generators. | Transformers. |
|---|---|---|---|
| Stave Falls ..... | 2-13,000 h.p. Francis. | 2-10,000 k.v.a., 4400 volts | 2 banks of 3-3000 kw. |

The foundations for the power house are of solid concrete construction, and the superstructure is a combined formation of steel and reinforced concrete. The building is 100 feet wide by 90 ft. long. The turbine and generator room is 75 ft. by 90 ft., and a two-story lean-to 28 ft. wide houses all the high tension and low tension switches. The control switchboard is on a gallery in a lean-to at the end of the building. The power house is now being extended 70 ft. more for the installion of two new units.

The 13,000 h.p. Francis type turbines were built by the Escher Wyss Company of Zurich, Switzerland. Excitation is provided by two 250 kw. 125 volt generators, each driven by its own turbine, and each capable of exciting four machines. Governors and oil pumps were also provided by the Escher Wyss Company, the pumps being driven by individual wheels of the impulse type.

A travelling crane of 70 tons capacity spans the entire main floor, placing the transformers as well as the generators and wheels directly under the crane. The control switchboard is in a gallery at the east end of the building, giving the operator full view of every piece of moving machinery. All switches are solenoid operated, and with the fuses, are located in reinforced concrete cells in a separate lean-to parallel to the main building.

**The Ocean Falls Company, Ltd.**

The property of the Ocean Falls Company, Ltd., is situated at Cousins Inlet, about 300 miles north of the City of Vancouver. Cheap power for the operation of its pulp and paper manufacturing plant is provided by the Link River project. The total capacity of the turbines at present installed amounts to 11,200 h.p., but provision has been made at the headworks for doubling this capacity at a later date.

The Ocean Falls Plant.

A small storage dam is provided at the lower end of Link Lake, and at a point about 800 ft. from the power house a concrete diversion dam has been installed on the Link River. This dam is provided with an intake section with two 12 ft. diameter openings for pipe line connections controlled by sluice gates. The dam is of gravity section, with a maximum height of 60 ft. above the lowest point of the foundation.

From the dam, the water is conveyed to the power house through one steel pipe line 12 ft. in diameter 776 ft. long. The lower end of the pipe line is parallel to the back wall of the power house; a branch pipe coming off the main pipe line is provided for each water wheel unit. Provision for a duplicate pipe line between the dam and the power house is provided for.

Three hydroelectric units are at present installed; consisting of 600 kw., 3-phase, 60-cycle, 440-volt Westinghouse generators, each driven direct by a turbine of 900 h.p. supplied by James Gordon & Company, operating under a head of 115 ft. A 50 kw. motor generator set supplies power for the electrically driven mono rail system used on the wharves for loading lumber, etc.

The units are controlled by an 8-panel Westinghouse switchboard.

For the operation of the pulp grinders, hydraulic turbines are provided; the grinders are in groups of four, each group being driven by a 1600 h.p. turbine of the Francis type, supplied by Jens Orten-Boving.

**Canadian Collieries (Dunsmuir) Ltd.**

The Puntledge River, which is the natural outlet of a lake of the same name, discharges into the Gulf of Georgia on the eastern side of Vancouver Island, British Columbia, at a point about 60 miles north of the City of Vancouver. The Canadian Collieries (Dunsmuir) Ltd., which owns and operates a group of coal mines at Union Bay, has developed the power possibilities of this stream, and the several steam plants which were formerly in operation at each of the company's mines, have been superseded by a central hydroelectric power plant with 13,200-volt distribution system, whereby considerable economy in operation has been effected.

The maximum recorded flow of the Puntledge River is 3500 cu. ft. per second, and the minimum is 330 cu. ft. per second. A study of the flow curves available showed that by creating sufficient storage in Puntledge Lake, a constant flow of 800 cu. ft. per second could be maintained.

An impounding dam was built at the outlet of the lake to raise the water 23 ft. above the original lake level and provides useful storage of 132,000 acre-feet.

From the outlets of the storage dam the water flows in the natural bed of the river to the diversion dam about 2½ miles below the lake.

At the diversion dam the water enters a system of canals and flumes 3400 ft. long, in which length there are many sharp curves necessitated by the broken nature of the country. The canal sections occur in solid rock, sand, gravel and clay, and with the exception of some portions in impervious clay, all are lined with concrete. The sections of the canal are connected by wooden flumes which have the same carrying capacity as the canal.

The pipe line intake is a vertical cylindrical chamber of reinforced concrete about 25 ft. in diameter and having a height above the bottom of the outlet opening of about 30 ft.

The elevation of the pipe line intake is 414 ft. above sea level, giving a static head of 350 ft. at the power house.

From the pipe line intake the water is carried in

a wood stave pipe 8 ft. in diameter and 4500 ft. long, to a "Y" structure with two outlets for 72 in. diameter pipes.

The power house is a reinforced concrete structure, built on a rocky site on the river bank. The present building provides space for two generating units and covers an area of 34 ft. by 117 ft., which is approximately half the area of the building contemplated for the ultimate development. The annex section of the power house has been built complete, and space is provided to accommodate all the switching and auxiliary electrical apparatus for the completed plant. This section of the building is three stories high and has a ground area of 18½ ft. by 65½ ft. It is built of reinforced concrete with concrete floors and roof.

There are installed in the power house two Escher Wyss turbines of the reaction type with multiple balanced gates operated by governor. Each unit is provided with a hydraulically operated gate vale in conjunction with the turbine. Under the available head of 350 ft. (static) each turbine is rated at 4700 h.p. at 500 revolutions per minute.

Directly connected to each of the two turbines is a 3-phase, 25-cycle, 3500-kw., 21,200-volt Canadian General Electric generator. To each unit an exciter is directly connected, the capacity of each of which is sufficient for the excitation of the two main units. The generators and outgoing lines are controlled by means of Canadian General Electric H-3 motor operated oil switches from a switchboard also supplied by the Canadian General Electric Company.

At various places on the property, substations are provided in which are installed oil insulated water cooled transformers with a total capacity of 6500 k.v.a., supplied by the Westinghouse Company.

All large motors are supplied with current at 2200 volts; the smaller motors operate at 440 volts. For supplying the latter motors, Westinghouse transformers of 2000 k.v.a. capacity, which step down the voltage from 2200 to 440 volts, are provided. All of the substation equipment was supplied by the Canadian Westinghouse Company.

For winding at the mine shafts and for driving compressors, etc., a number of large motors are provided, the largest of which is 750 h.p. These motors are of the three-phase, 25-cycle, 2200-volt type, and are either of the slip-ring or self-starting synchronous pattern.

The ventilating fans are driven by two 350 h.p. Westinghouse, 3-phase, 25-cycle, 2200-volt slip-ring motors running at 250 revolutions per minute, and are provided with Westinghouse automatic liquid self-starters. When for any reason power is cut off, the automatic liquid self-starters open the motor circuits, and when the power is restored the self-starters automatically connect the primary of the motor to the line: by means of a small motor the resistance in the secondary of the fan motor is gradually reduced, and the fan motor is thus slowly brought up to full speed, when its slip-rings are short circuited.

The cost of the present development is slightly under $70 per horsepower at the power house switchboard. When the plant is completed to its ultimate capacity, the cost per horsepower will be reduced to about $60.

(To be continued.)

## REPORT ON COLUMBIA RIVER POWER PROJECT.

### Appendix C—The Meteorological Conditions Causing the Flood of 1894 and Low Stages in the Columbia River in 1890 and 1912.

BY EDWARD A. BEALS,
District Forecaster, U. S. Weather Bureau, Portland, Ore.

The amount of water in a river is wholly dependent upon rainfall. By rainfall is meant precipitation of every character, whether it be rain, snow, hail, sleet, dew or frost. It would therefore seem as if we could easily determine the run-off of a river if we knew the amount of rainfall within its catchment basin; but such is not the case, owing to the diversified action of water after being deposited on the ground. Some soils are absorbent and some are not; also the absorbent qualities of soils vary from time to time. Some of the rainfall is evaporated, some seeps slowly into the soil and may find an outlet years later in the same or another drainage area, and some may remain frozen for many years, if not centuries.

Within the Columbia River drainage area of 259,000 square miles there are now in operation about 385 rainfall stations, of which about 285 are equipped to record both temperature and rainfall. Most of these stations are in the United States, not more than 35 being located north of the Canadian boundary. If these stations were at equal distances apart, there would be one rainfall station for every 673 square miles and one temperature station for every 909 square miles, which number is inadequate for obtaining an accurate measurement of the precipitation in the Columbia River drainage area. Furthermore, a large proportion of the stations are located in the settled valleys, and only a few are located high up in the mountains, where the precipitation is heaviest.

In discussing the effect of rainfall on stream flow in the Columbia River Valley, the first obstacle, even at the present time, is inadequate information regarding the rainfall. Twenty-five years ago the number of rainfall stations in the Columbia River Valley could almost be counted on the fingers of one hand; there were none in British Columbia, and those in the United States were all located in valleys where the rainfall was light. Fortunately, the temperature and rainfall at a few stations reflect in a general way the conditions over a much larger area, and with the data at hand we can form some idea of the climatic effect on stream flow, which it is proposed to do in the case of the high water in the Columbia River in 1894 and the low water in 1890 and again in 1912.

#### Flood of 1894.

In 1894 the highest water ever known occurred in the Columbia River and its principal tributaries. From a published Weather Bureau report, entitled "Daily River Stages" (W. B. No. 507), the flood crest at a number of places was as follows:

| | | | |
|---|---|---|---|
| Bonners Ferry, Idaho | 38.0 ft., | June, | 1894 |
| Northport, Wash. | 53.0 ft., | June 7, | 1894 |
| Wenatchee, Wash. | 58.0 ft., | June 10 to 13, | 1894 |
| Kennewick, Wash. | 32.0 ft., | June | 1894 |
| Weiser, Idaho | 26.5 ft., | June 5, | 1894 |
| Lewiston, Idaho | 26.6 ft., | June 6, | 1894 |
| Riparia, Wash. | 24.7 ft., | June 5, | 1894 |
| Umatilla, Ore. | 34.5 ft., | June 5, | 1894 |
| The Dalles, Ore. | 59.6 ft., | June 6, | 1894 |
| Cascade Locks, Ore. | 40.7 ft., | June 6, | 1894 |
| Vancouver, Wash. | 34.4 ft., | June 7, | 1894 |

By far the largest portion of the water causing this great flood was from melting snow in the moun-

tains and foothills. In a large drainage area like that of the Columbia River there can be a large amount of snow in the mountains with a small resulting annual rise, or a moderate amount of snow and a large flood. If the amount of snow is small, it is almost certain that the ensuing flood will likewise be small, but under favorable conditions even a small amount of snow might cause a serious flood of short duration.

Should the snow in the drainage areas of the different tributaries so melt as to cause the flood waters of each tributary to reach the main stream when at its highest stage, the result would be a disastrous flood of short duration even with a small amount of snow. Fortunately, such a condition never has occurred and probably never will.

The most important tributary of the Columbia River is the Snake River, which discharges about 60 per cent as much water as does the Columbia River above the mouth of the Snake River. Should the flood crest in the Snake River meet the flood crest coming down the Columbia River, we will have a greater flood in the lower stretches of the Columbia River than would be the case if the Snake River flood crest passed into the Columbia River ahead of the Columbia River crest. The Snake River flood crest always passes into the Columbia River ahead of the latter's crest, for the reason that warm weather begins first in the south and does not reach higher altitudes until later in the season. The headwaters of the Snake River are in the Yellowstone Park, while the headwaters of the Columbia River are in British Columbia. Consequently, the snow begins to melt at the headwaters of the Snake River, before it does at the headwaters of the Columbia River.

Sometimes a general warm wave will sweep over the Northern Rocky Mountains, and the snow melts almost as soon in British Columbia as it does in Yellowstone Park, and when these conditions occur the Snake River flood crest is only a few days ahead of the Columbia River flood crest. In 1894 the Snake River crest passed into the Columbia River only three days ahead of the Columbia River crest, and this fact was one of the factors in making the annual rise of 1894 such a memorable one. The average time the Snake River flood crest reaches the Columbia River is May 28th, and the average time the flood crest from the Upper Columbia River reaches the mouth of the Snake River is June 14th, or seventeen days later.

The only stations available for showing the weather conditions prior to and during the flood of 1894 are Baker, Ore., Spokane, Wash., and Boise, Idaho, to which have been added Helena, Mont., and Lander, Wyo., both outside of the drainage area of the Columbia River, but near enough to it to reflect the general conditions. From the records at these stations the departures from normal temperature and rainfall have been computed, and they are shown in Fig. 19, together with the average monthly stages of the Columbia River at Cascade Locks.

From this diagram it can be seen that there was an excess of moisture during the winter of 1892-93 and in the spring of 1893; also that the summer and fall of 1893 were cool. It is therefore likely that there was more hold-over snow in the high mountains in 1893 than usual. In consequence of the cool summer following there was less evaporation, with the result that the ground water level should have been higher than usual at the beginning of the winter of 1893-94.

In September, October and November, 1893, there was a marked excess in precipitation with temperatures slightly below normal. The December snowfall was light, but the January fall was far greater than usual. The February amount was nearly normal, but in the following month of March it was again heavy, making altogether six out of seven months with pre-

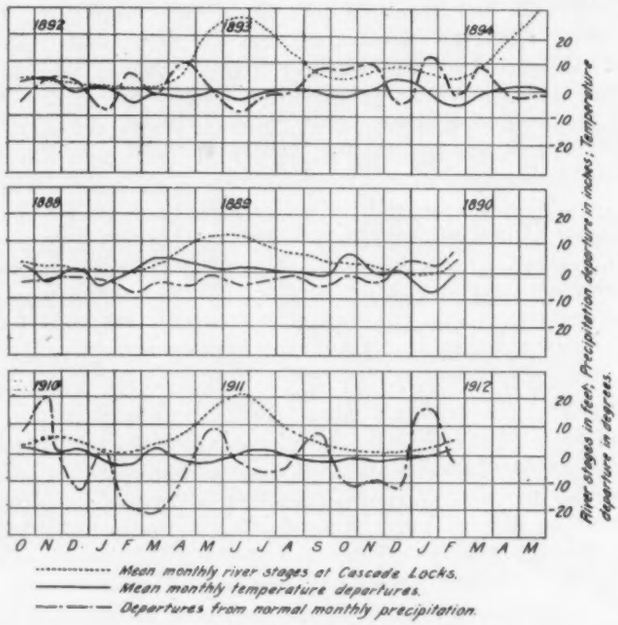



Fig. 19. Meteorological Data.

cipitation nearly normal or above normal. December, with its light fall of snow, was mild, which would cause the snow to pack solidly and make a firm foundation for the heavy deposits in February and March. February, 1894, being very cold, with nearly normal precipitation, all the snow of the preceding months was conserved, together with that which fell in February, so that with the addition of the heavy fall in March the amount in the mountains on April 1st was enormous. The temperatures during March were slightly below normal, but April and May were warm months, and under the influence of the temperatures prevailing at that time the snow quickly melted and the biggest flood in the history of the country occurred. Just how low the river went is not known definitely, but on January 7th a reading was made on the gage below the locks from which a gage height of —3.9 ft. on the Cascade Locks gage was estimated. There is no other record from January 3d to 16th, inclusive, and the stage may at times have gone even lower than this.

### Low Water of 1890.

Very low water in the Columbia River nearly, if not always, occurs during periods of low temperature. Should the preceding summer be dry and the ground water which supplies the springs be low, we can expect low water the following winter, and if cold weather sets in for any great length of time, very low stages will occur.

In 1890 these conditions prevailed, and the river at Cascade Locks was below the zero mark for 44 days beginning December 16, 1889, and lasting up to and including January 29, 1890. Just how low the river went is unknown, but on January 17-18 stages

of —2.0 ft. were recorded. There is no record from January 3d to January 16, inclusive, owing to the river being frozen, and it is probable even lower stages prevailed during a portion of that time.

During the period preceding and during this low water we have only two stations available for determining the weather conditions in the Columbia River drainage area above Cascade Locks, viz., Spokane, Wash., and Boise, Idaho. If to these two stations we add Helena, Mont., and Fort Washakia Wyo., just outside the drainage area, we will have four stations that can be used to reflect the general conditions prevailing at the time.

From the records at the foregoing stations the monthly mean temperature and the monthly average rainfall have been determined, and these data, together with the average monthly height of the river at Cascade Locks, are graphically presented in Fig. 19.

The first striking feature of this record is the deficiency in precipitation, which is seen to have been continuous from October, 1888, to November, 1889, or fourteen months altogether. The spring of 1889 was unusually warm, and the temperatures during the summer months were slightly above normal. It was slightly cooler than usual in September and November, but October was a warm month. These conditions would cause the water in all streams within the Columbia River drainage area to be very low up to and including the month of November, 1889. In December the temperatures were nearly normal, and the precipitation was heavier than usual. With normal temperatures in December most of the precipitation above the Cascade Locks would be in the form of snow, and very little would melt; therefore no great amount would run off into the river, and consequently we would expect the main stream to continue to fall, which was just what occurred. Furthermore, owing to the warm spring and summer, evaporation must have been great, and the deficiency in precipitation and high rate of evaporation through these seasons, as well as the deficient precipitation during the preceding winter, could not help but have lowered the level of the ground water, and thus lessened the supply from that source.

At The Dalles, Ore., the average of the daily minimum temperatures in January, 1890, was 15 deg., and from the 4th to the 13th, inclusive, the temperatures ranged from 10 deg. above zero to —12 deg. (below zero), which is very cold weather for that place. The river undoubtedly was frozen to a depth of several inches at Cascade Locks and on up the stream to its source. Under these conditions ice gorges form in the neighborhood of Celilo, as well as at many other places on the main stream and its tributaries. These gorges hold back more or less water, and a very low stage should have been expected above tide water in the lower portion of the river.

### Low Water in 1912.

The large number of records used to determine the weather conditions during and preceding the low water of 1912 complicates the situation, and whereas with more records we ought to be able to obtain a clearer insight into the causes of the changes that take place in our rivers, it is more difficult to segregate unimportant data from that which is important in the mass of figures obtained, and irregularities occur that cannot always be satisfactorily explained. The British Columbia stations were not available in this discussion, and a few stations in the Coast, Southern Oregon and Puget Sound drainage areas were included in the means obtained. It is believed the omission of the British Columbia stations and the addition of others will not materially affect the results, as the number in the drainage area of the Columbia River greatly overbalances the others.

The monthly mean temperature from nearly 250 stations and the monthly rainfall from 350 stations altogether, with a graph of the monthly stages of the river at Cascade Locks, are shown in Fig. 19.

From these data it is seen there were slight departures from normal temperature during the winter of 1910-11, with a moderate fall of snow in the early winter and a large deficiency in February and March. This distribution is favorable for slow melting, and the crest of the 1911 annual rise did not reach the Cascade Locks until nearly the middle of June. There was an excess of precipitation during May and September, and a marked deficiency in March and April, during the summer months, and from October to December, inclusive. March and July, 1911, were warm months, while the remaining months that year were cool.

The weather conditions preceding the low water of 1912 would not in themselves indicate a markedly diminished supply of ground water. There was a general tendency in that direction, however, and the deficient rainfall and cool weather from October to December, inclusive, 1911 followed by a period of severe cold in the early part of January, caused a culmination of the drought in the extreme low water of January 5th to 11th. This cold period at The Dalles, Ore., was most severe on January 7th, 8th and 9th. On the 8th the minimum temperature was —11 deg. Heavy ice was running in the river on January 3d and 4th, and it was frozen from January 5th to January 16th, inclusive. On the 8th 31 in. of snow fell, and during the first ten days of the month the total snowfall was nearly 48 inches.

The lowest stage recorded at The Dalles was —1.8 ft. on the 8th and 9th, at which time the river was frozen and covered with a heavy fall of snow. As in the low water of 1890, ice gorges farther up stream must have held back more or less water, so that this low stage is not a good indication of the amount of water in the river above The Dalles at that time. At Cascade Locks the lowest stage was —2.2 on January 10th, and the river was frozen from the 7th to the 11th, inclusive.

In conclusion, it can be seen that high water depends primarily upon the way the snow melts in the mountains at the headwaters of the Columbia River and its tributaries during the spring months, and, secondarily, upon the amount of snow in those mountains. Low water is caused primarily by deficient precipitation for one or more seasons, and secondarily by weather cold enough to freeze the river and allow the formation of ice gorges above the places where measurements are made. A third factor in causing low water is a diminished supply of ground water, and this is due to deficient rainfall for protracted periods covering one or more years.

(To be continued.)

## THE NEED FOR A CONSISTENT GENERAL STATE POLICY AS TO PUBLIC UTILITIES.

BY CLYDE B. AITCHISON.

(Concluded.)

So far nothing has been said as to the essentially monopolistic character of the business performed. The best authority now regards the existence of an actual or virtual monopoly as wholly immaterial to the right to supervise the public utility business, and places the right upon other grounds, already suggested. But whether the business is to be one of free competition, or of virtual monopoly, is a basic factor in a complete policy.

If the state is to invite private enterprise to perform its governmental functions, it must deal as feairly with the utility as it expects the utlity to deal fairly with it. The investment invited must, to the extent that it is prudently and honestly made, be given such reasonable safeguards that in the long run capital will continue to be invested in such enterprises. It has often been pointed out that public utility investments are of a fixed character; the property stays where it is put, and the owner cannot load it upon the cars and take it elsewhere when market conditions do not suit him in the locality where he has made his investment. In no way can the permanency and attractiveness of the public utility service be impaired more quickly than by unnecessary and useless competition admitted or permitted in an already insufficient field. There is no denying that competition often brings temporary gains to present consumers; and there can be no doubt it is sometimes necessary as a disciplinary measure for a utility which has failed in its duty and for the protection of the public. Likewise there can be no doubt that unnecessary or destructive competition ultimately does the community more harm than it accomplishes temporary benefit; that even for temporary benefits there comes a time of repayment with interest; and that the effects on the state as a whole are deleterious. The most aggravated case of all is where the municipality, through partisan or ill-considered motives, enters into competition—an unregulated free lance—against a regulated, privately owned utility. This situation is met elsewhere, and can be met here by a proper certificate of convenience and necessity law, which will permit the working out of a central, well rounded policy, and simultaneously secure to the local communities permanently all the benefits they now secure temporarily through barbaric competitive warfare. It can be conservatively stated that the rate of return which the utility investor might expect and could lawfully demand in protection of his investment as against a schedule made by a rate regulating body, would be lessened in this state at least one and a quarter per cent per annum. An amount roughly equal to ten per cent of the total existing utility rate schedules is now being paid needlessly, as a premium for the privilege of setting utility corporations on to each other to see which can first be bankrupted. The state is strewn with financial wrecks left after such unnecessary competitive storms have ended, and even the beach combers have nothing to show for their accumulations.

We have indicated that a sound policy would be one which would insure that the enterprise would be carried on without interruption of service, and would be financially possible at reasonably low rates. The state has a decided interest in the financing of the public utility corporations which engage in its service. Good business requires that an agent should not be entrusted with so important matters unless his own financial affairs are in such shape he will be able to carry the undertaking through. Receivers make poor operators for public utility plants. Some experience with such matters warrants a rather dogmatic statement that financial troubles of public utility corporations usually grow out of their capital issues and funded and other long term indebtedness, rather than form temporary money conditions, insufficient rates, or service emergencies. It is useless to disguise the fact that there has been wild-catting in the financing of some public utility corporations, which is now resulting in calls for settlement which are decidedly embarrassing in certain quarters. Some of the records of the organization and financing of public utility corporations brought to official notice sound more like the deliberations of Wallingford, Daw, and Onion Jones than the transactions of serious and honest business men undertaking the responsibilities of a high public calling. But the present desperate situation of these concerns, facing the necessity for reorganiation and the plight of innocent investors shrinking sums paid by them for common stock having absurd nominal par value, and the maledictions they heap on the state for permitting all this, divest such transactions of any element of humor. These things reflect upon the credit of the state. If an outside investor has his choice between utility securities, one of which has been supervised by the state in which the property is located, to insure a fair relationship between nominal capitalization and actual value, and honest methods of accounting and application of the proceeds, and the other of which is in a state where no such safeguards have been thrown around the transaction, in which state will investment be made more readily? In which state will the interest rate expected be the lesser? The questions answer themselves.

Every incentive for consistent business policy calls for the reasonable regulation of the issuance of capitalization and funded debt of utility corporations, for the protection of the credit of the state, in order that the interest rate may be kept at the lowest possible figure, and to insure the carrying out by the utility agency of the public profession which it makes. This policy is being consistently followed as an integral part of the public utility program elsewhere, and at least until such time as the federal government undertakes it, a state which omits these necessary precautions is failing in a plain duty.

The recognition of the public character of the public utility employment and the state-wide responsibilities assumed in the calling raises some questions as to policy in the intercorporate or inter-utility relations of these concerns. The postulate made is that the policy adopted shall be such as eventually will prove of the greatest advantage for the widest possible community. This would require, as sound policy, the avoidance of economic waste both by avoidance of useless duplication of facilities and by requiring the interchange of traffic and service in proper cases. The utili-

ties, as agents of the same principal, owe it the duty of furthering the interests of their principal by co-operation. Here again the distinction between the momentarily advantageous and eventually profitable is to be kept clearly in mind by the utility which is reluctant to declare a truce and act in harmony with its former competitors in the future joint service of the commonwealth.

As details in the program, one requirement of which is the preservation of the utility's service in an unimpaired condition, proper accounting methods and the establishment and proper expenditure of reasonable depreciation and renewal reserves or funds may be mentioned. These requirements have usually been made with more or less vigor by the public service commissions, and are being worked out with some degree of consistency. They are mentioned, therefore, rather than discussed. In like manner may be passed with casual reference the creation of public service commissions in practically all jurisdictions with the primary objects of securing the adequacy of service and reasonableness and equality of rates which the law requires. The policy to be evolved by the states will naturally center around the present activities of the public service commissions. There is need of correlation of the functions of such commissions with those of other tribunals dealing with other phases of the subject; and, in the case of interstate utilities, with the federal commission similar bodies in other states.

It might as well be understood, however, that the work performed by such commissions, to be effective, must be of a highly technical character, covering a wide diversity of fields, and cannot be performed with credit to the state or the commission or with full justice to the utility or its patrons except by the expenditure of sufficient money to procure high grade expert assistance of sufficient quantity to permit prompt attention to matters which require investigation. A state which cannot afford to spend enough to insure thorough, expert work, would far better restrict rather than increase the scope of duties of the commission until its financial conditions warrant paying for what it expects.

A rational and consistent state policy as to public utilities would pay particular attention to the question of taxation, including the general property tax and the various local occupation and other license fees exacted.

Undoubtedly in determining the economic cost of public utility service there must be taken into consideration the repayment by those receiving the service for the special benefits conferred upon them through the medium of the utility corporation. There can be no objection to the imposition of a reasonable tax upon the utility's property, fairly commensurate with the benefits the state confers and the expenses the state is put to in the safeguarding of the property and those engaged in operating it. This would logically include the indirect expenses of the state as well as first cost due to the exercise of the police power. These expenditures should be borne by the utility service, equally with insurance and other comparable items.

It cannot be admitted, however, that the best tax is that which succeeds in plucking the maximum amount of feathers from the goose with the least amount of squawk. At least, the goose could scarcely be expected to subscribe to such a doctrine.

Generally speaking, no great attention has been paid to the question of public utility taxation in connection with the development of a rounded policy. It has been recognized for a considerable time that the peculiar relation between the utility and the public, whereby the public service corporation is permitted to shift the tax burden onto its consumer directly, and still demand protection and compensation rates for its investment and service, makes it relatively easy to impose tax burdens upon public utility properties. In consequence, taxes have been and are imposed entirely as if, by some legerdemain, the tax money was extracted from the pockets of some invisible, intangible, non-resident and non-resistent stockholder, who was powerless to oppose and absorbed the excessive burden without attempt to retaliate in the way of diminished quality or extent of service, or by increasing rates or withholding reductions in schedules. This manifests itself in the property tax by assessments which exceed the value the property would bear if in private service—always supposing a correct equalization—supposed to be for the intangible franchise or earning power; and in the municipalities we find gross earnings and fixed amount occupation taxes imposed as conditions precedent to the right to serve the public at all. If the assumption which underlies every attempt at the collection of an undue amount from a public service agency were correct, and the excess in fact was absorbed by the utility owner, it might be temporarily to advantage to resort to such methods of raising public moneys, although the ethical situation would not be altered. But anyone who assumes that such unduly burdensome taxation is borne by anyone other than the resident utility patrons and the community as a whole, either in the way of rates maintained higher than they should be, or curtailed service, is very ignorant or purposely uncandid.

On the other hand, it is equally important there be a proper apportionment of these governmental costs to the utility service; otherwise, the general property assumes part of the cost of furnishing the service to a particular class of citizens, or if regulation be imperfect, the returns of the investor are unduly large.

The tax problem is larger than merely getting of revenue for the state, and for its municipal governments. It deserves consideration as a part of the whole policy, because of the close connection between rates and service on the one hand, and the making of the public utility business sufficiently attractive to maintain the investment of private capital therein on the other. Particularly should the problem be divorced from local consideration.

In passing, it may be observed that the patrons of the municipally owned utilities owe a similar duty to the general property owners to contribute their fair share to defray the cost of the special benefits received. Generally there is no account taken of this in municipal operation of its utility plants. The result is a concealed but none the less effectual shifting of these costs from the one who is benefited to a larger class, many of whom are not benefited by the service, and then the costs are apportioned by a rule which has no relationship either to the cost of performing the service or the benefits conferred.

## DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

### Care and Operation of Earlier Types of Engines.

[Continued.]

When the engine is running, careful watch must be kept on the pressure of the spray air. The appearance of the exhaust will indicate whether the air is too low or too high. If it is too high, a pound will be heard on the fuel valve and white smoke will appear. If too low, black smoky exhaust will appear. It is always advisable, if possible, to let the circulating water run for ten or fifteen minutes after the engine is shut down so as to cool it off gradually. The tops of the pistons in a Diesel engine naturally become very warm while running under load and when the engine is shut down, if the circulating water is cut off at once, the pistons in a stationary position will heat the water in the cylinder jacket around them so hot that the lubricating oil will run off the pistons and there will be nothing left to lubricate them when the engine is again started. This would naturally add to the loss of compression and sometimes causes trouble in starting. Then again the hot pistons would cause the gummy oil that is around the rings to fry and cook and naturally cause the rings to stick. Also the heat from the piston will heat the wrist pin at this time, which causes the oil to run off of that, and when the engine is started it is some time before lubricating oil can again reach this point.

In stopping the engine, if possible, throw the load off gradually. If it is necessary at any time to shut the engine down quickly in case of accident or for some other reason, the quickest way is to shut off the fuel and let the engine stop or die with the load on.

In nearly all Diesel engines there is a small hole provided somewhere in the exhaust valve cage which allows the engineer to inject a little coal oil on the exhaust valve stem. The reason for this is that with a small load on the engine the exhaust valve stem is liable to become gummed with the unburnt oil. This, of course, greatly depends upon the kind of fuel oil being used. A fuel oil high in asphalt is more liable to cause gumming than oil with a paraffine base. When using an oil with an asphalt base it is always quite necessary to put coal oil in the exhaust valve stems before shutting down. The spray air should never be shut off the engine until it is almost stopped. The first thing to do is to shut off the fuel, which is the life of the engine. As the engine starts to slow down the bleeders on the air compressor should be opened. When the engine is at a standstill close the lubricators on the engine and the compressor and close the valves on the air bottle as tightly as possible.

The care of the valves of a Diesel engine is a very important thing, as the success of the operation depends entirely upon their being kept tight. The writer would advise the owner of a Diesel engine or a prospective purchaser, to always have a number of spare parts on hand, the most essential being one admission valve and one exhaust valve complete. By this is meant the valves and the cages in which they set. In this way on Sunday, if that is the day the engine is to be shut down for a few hours' inspection, the admission valve and exhaust valve can be taken out of one cylinder and the two valves in perfect condition put in their place. The following week the engineer could see that those taken out were put in condition and ready for the next change. This could be continued, say every three or four weeks, so there never would be a time when it was necessary to shut the engine down to grind valves, and by so doing the valves would always be in good condition. If the engineer tries to grind valves on a Sunday, or any day that might be selected for the two or three hour shut down, he naturally does the work in a hurry, the valves being more or less hot and the work is not done properly. In grinding either the exhaust or admission valve it may be often observed after grinding a few minutes that the valve and seat will appear to be in perfect condition but it is always a good idea to test the seats before putting the valves together. A good way to do that is to wipe the seat of the cage and the valve as clean as possible and then mark the seat crosswise about 1 inch apart all the way around with a lead pencil. Then put the valve in place and give it half a turn. If by so doing all pencil marks are cut off the valve has a perfect seat. If any of the marks are left it is necessary to keep on grinding until they all come off by turning the valve, giving an absolute assurance of a good seat.

Nearly all Diesel engine builders furnish with the engine a number of spare parts, consisting of one fuel needle, one atomizer, one fuel pump plunger, one fuel pump suction valve, one fuel pump discharge valve, one complete set of springs for all valves and one complete set of gaskets. But to have a safe supply of spare parts everything they furnish singly should be brought up to the number of cylinders on the engine. In this way if it is a three-cylinder engine there should be three of each of the parts, while if of four cylinders four of each except gaskets. Of these there cannot be too many, and it is always advisable to have at least a half dozen piston rings on hand. The cylinder heads should be lifted at least once a year, the pistons taken from the engine, the wrist pin taken out and the bearings examined and refitted. All rings should be removed from the piston, the ring grooves and rings thoroughly cleaned and if any of the rings show wear they should be replaced. At such a time during the overhauling of the engine all bearing caps should be lifted and the shaft and bearings examined, as much as possible, then the caps reset and locked.

If the engine is of splash lubrication the lubricating oil should be cleaned out of the crank case at least once in six months. If there is leakage by the rings due to wear or stuck rings, it is necessary to clean the crank case at shorter intervals. The engineer can always judge the condition of the oil in the crank case by its color. Even though the oil might look dark, by taking a small quantity on your finger and going to the sunlight, if you can get a green shade the oil is still good. If the oil shows black in the sunlight it is time to clean the crank case. The proper way of doing this work is to bail out all the oil and water that can be taken from the crank case. It is good practice, at such a time, to start the engine up with the doors off and watch the lost motion or anything that might be loose in the crank case and cannot be seen at any other time, but it is inadvisable to run

the engine longer than five minutes as the crank pins will get hot. After this inspection is finished put in the regular amount of water that would ordinarily be followed by a new supply of lubricating oil, then add three or four pails of fuel oil to each crank pit, put the doors on and start the engine and run it for 15 minutes. It will be found when the doors are taken off that the working parts of the engine are thoroughly washed off, this method cleaning the bearings where it is impossible to wipe out the dirt. It also prevents either the lint from rags or waste that might be used in cleaning remaining in the crank case and finally after running collecting in the lubricating holes of the bearings. The water and oil should then be bailed out and thrown away, the usual amount of water and lubricating oil placed in the case ready for running. Waste should never be used at any time inside of the engine, or in any place where it might fall in while the doors are off.

In the setting of the main bearing caps it is a good idea, in order that the clearance may be known exactly, to use No. 10 fuse wire, placing four pieces across the shaft, one at each end and two near the center, then putting the cap on and pulling down as hard on the nuts as possible so as to allow about .006 clearance, then mark the nuts and bearing with a center punch so that they may be brought back to the same place. After removing the wires build up with metal shims until it is all you can do to pull the nuts down to the marked places. Then your cap will be solid and you know the clearance is correct.

After once going over the engine in this way and resetting caps with thin shims it will be easier to make the adjustments from that on as one can be taken out from each side, the cap pulled down as hard as possible and the engine turned over; if it turns free it is all right to go ahead with another run or until it is necessary to overhaul again.

The admission valve is contained in a cage designed to permit the removal of both valve and seat to allow of easy access for grinding. If the valve should get into bad condition it may be necessary to ream the seat and face the valve. This should rarely be necessary, but if done, great care should be used in maintaining a true and even pressure on both valve and seat at an angle of 45 degrees. Every precaution must be exercised to remove all cuttings or emery and all parts should be thoroughly cleaned. When replacing the admission valve cage into the cylinder head see that all contact surfaces of both the head and cage are well cleaned and that the gasket is in good condition. Tighten the holding down nuts with a wrench only. Do not use a hammer or length of pipe on the wrench and be careful to get the cage down evenly on the joint. After starting the engine watch the valve for evidence of leak, and should there be a sign of one carefully draw up on the nuts. Do not delay doing this or the gasket will rapidly burn at the leak and have to be replaced. A leaky admission cage will cause a serious loss of power.

(To be continued.)

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**Electric iron ore smelting** is a commercial success at Soderfos, Sweden, where a 4500 kw. furnace is employed. With a current consumption of rather more than 3000 k.v.a., the average production of pig iron is 250 tons weekly, with a consumption of 77 cu. ft. of charcoal and 15½ lb. of electrodes per ton of iron. For three 2200 kw. furnaces at Hayfors 48 men are required, their wages per ton being 94½ cents. These three furnaces cost about $250,000, of which the buildings, furnaces and transformers cost about one-fourth each respectively.

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**Polarization of Leclanche cells** is not due to hydrogen, as is generally supposed, but to ammonia, which is liberated by the splitting up of the ammonium radical, combining with the water to form ammonium hydroxide, and hence hydroxyl ions by dissociation. These hydroxyl ions bring about polarization. The dissociation of the ammonium hydroxide can be prevented by the addition of excess of ammonium chloride and the polarization thus diminished, but the best method is to add zinc chloride, which gives rise to complex zinc ammonia compounds, thus preventing, to a large extent, the formation of ammonium hydroxide and hence of hydroxyl ions.

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**The epoch-making inventions** of the world have mostly been made by Americans, as is shown in the following list as prepared for the annual report of the Secretary of the Interior:

| American Inventions. | Inventor. | Date |
|---|---|---|
| Telephone | Bell | 1876 |
| Typewriter | Sholes | 1878 |
| Cash register | Patterson | 1885 |
| Incandescent lamp | Edison | 1880 |
| Talking machine | Edison | 1878 |
| Electric furnace reduction | Cowles | 1885 |
| Electrolytic alkali production | Castner | 1890 |
| Transparent photograph film | Eastman | 1888 |
| Motion-picture machine | Edison | 1893 |
| Buttonhole sewing machine | Reece | 1881 |
| Carborundum | Acheson | 1891 |
| Calcium carbide | Willson | 1888 |
| Artificial graphite | Acheson | 1896 |
| Split-phase induction motor | Tesla | 1887 |
| Air brake | Westinghouse | 1869 |
| Electric welding | Thomson | 1889 |
| Type-bar casting | Mergenthaler | 1885 |
| Chain-stitch shoesewing machine | French & Myers | 1881 |
| Single-type composing machine. | Lanston | 1887 |
| Continuous-process match machine | Beecher | 1888 |
| Chrome tanning | Schulz | 1884 |
| Disk plows (modern type) | Hardy | 1896 |
| Welt machine | Goodyear | 1871 |
| Electric lamp | Brush | 1879 |
| Recording adding machine | Burroughs | 1888 |
| Celluloid | Hyatt | 1870 |
| Automatic knot-tying harvester machine | Appleby | 1880 |
| Water gas | Lowe | 1875 |
| Machine for making barbed wire | Glidden | 1875 |
| Rotary converter | Bradley | 1887 |
| Automatic car coupler | Janney | 1873 |
| High-speed steel | Taylor & White | 1901 |
| Dry-air process for blast furnace | Gayley | 1894 |
| Block signals for railways | Robinson | 1872 |
| Trolley car | Van Depoele & Sprague | 1874-1887 |
| Harveyized armor plate | Harvey | 1891 |

| Foreign Inventions. | Date. | Inventor. | Nationality. |
|---|---|---|---|
| Electric steel | 1900 | Heroult | French |
| Dynamite | 1867 | Nobel | Swedish |
| Artificial alizarene (dye) | 1869 | Graebe & Lieberman | German |
| Siphon recorder | 1874 | Thompson | English |
| Gas engine, Otto cycle | 1877 | Otto | German |
| Wireless telegraphy | 1900 | Marconi | Italian |
| Smokeless powder | 1886 | Vielle | French |
| Diesel oil motor | 1900 | Diesel | German |
| Centrifugal creamer | 1880 | De Laval | Swedish |
| Manganesé steel | 1884 | Hadfield | English |
| Electric Transformer | 1883 | Gaulard & Gibbs | English |
| Cyanide process for extracting metal | 1888 | Arthur & DeForrest | English |
| Mantle burner | 1890 | Welsbach | Austrian |
| By-product coke oven | 1893 | Hoffman | Austrian |

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**Nineteen Hundred and Fifteen**

As the old year is thrown on the scrap heap of the ages, obsolete and depreciated, a word of absolute appreciation is fitting. To the West, particularly, nineteen hundred and fifteen has been kind, for it has been a time for making new friends. The attractions of two expositions conjoined with the distractions in Europe to turn the tide of travel to the West. "See America first," to many an American, has acquired a new meaning with the Pacific Coast as the object of the seeing. Most of those who came and saw have been conquered by the desirability of the West as a place to live. Those who were entertained as friends and guests will be doubly welcome as friends and neighbors.

As nineteen fifteen, the exposition year, passes into the past, the West faces a fair future. Its advantages have been advertised, new peoples are preparing to make prosperous homes in its pleasant surroundings, and there is hope of legislative relief from the past onerous restrictions to a natural development of natural resources.

The old year, that is even now lightened of its load as the new year is brought up to synchronism, has been one of getting ready rather than of actual doing, particularly as regards engineering construction. New mines have been opened, new industries started and new plans made for greater production.

The most notable electrical features of the year in the West have been the illumination of the Panama-Pacific International Exposition and the electrification of the Montana division of the St. Paul railroad. These are noteworthy because each is the prototype of the lighting and traction methods of the next few years to come. Already the flood lighting so successfully employed at San Francisco has been applied in other localities and the next decade, also, should witness the electric operation of most of the railroads within transmission distance of a hydroelectric plant.

The revival in mining has brought with it an increased use of electric power for hoisting and milling. Electric irrigation pumping as a current consumer is constantly increasing and the improvements in electric ranges and the energetic sales policy pursued, have combined to threaten to tax the generating capacity of some companies.

Yet there are those who say that "more rapid development of waterpower in the West is mainly prevented by the lack of consumers rather than by the absence of suitable legislation." While the West will welcome more men, its per capita use of hydroelectric power, while the highest in the country, has just started. The more electricity a man uses, the more he wants to use. In Nevada there is being tried out a new process for the electric extraction of nitrogen from the air, which, if succesful will double the use of electricity in that state. The latent and wasting water powers of Oregon and Washington are needed to propel the railway locomotives instead of by the wasteful consumption of expensive fuel. More abundant power will cheapen mining costs in Arizona and more intensive application will lighten labor in California.

While the West needs more men it also needs laws which will make it possible to use the water that is now going to waste. This is the promise which the new year is expected to fulfill.

**The Whole Duty of the Whole Lighting Industry**

Periods of transition create balance-distributing conditions which urge the necessity for properly letting go the past in order to grasp the present, and thus be prepared for whatever improvement the future may afford. The partial reason for this is that it is difficult to entirely discard old equipment of proven service for the untried new, no matter how brilliant the promise of performance.

So, though "the old order changeth" in lighting, as in other fields, it is not true that it yields place without considerable opposition, to the new. Until they demonstrate their utility or desirability and thus overcome the inertia of past activities and expenditures, innovations will be opposed. To overcome this opposition is to uncover opportunity and makes for business permanence.

In lighting there are economic reasons for customers clinging to things as they are. These, combined with the fear of further progress which shall render obsolete the new things of the now, sometimes makes difficult the proper and complete use of the best equipment available.

To hastily review the remarkable lighting progress of the past few years, both in improved artificial light sources and their equipment, is to excuse somewhat the tendency on the part of the consumer to view the adoption of new ways and methods with alarm or at least with displeasure rather than in that opposite state of mind which the manufacturers of lamps and equipment, jobbers, dealers, contractors and others interested would much rather perceive.

But to put new wine into old bottles can be no more disastrous than the use of the new high efficiency lamps of increased brilliancy in old equipment neither suitable, nor useful for properly redirecting or diffusing the light; esthetically displeasing and dangerous to the eyes. The abortive attempts of the would-be economists and the uninitiated to adapt old equipment to the latest lamps and the use of these also without auxiliary equipment of whatever kind, are an affliction to be seen—or thrust upon you—in whatever direction the eyes may turn.

In this last transitional period which is also a prophecy of the future warning signal of what to avoid, conditions positively dangerous to eyesight have been created. These call for an aggressive educational campaign and sales policy on the part of the whole industry that electric lighting shall not through misuse fall into disrepute and an all-round loss of revenue result.

In certain localities an adverse business situation makes such collective effort in dealing with the customer difficult and these localities show the further need for lighting legislation—such as that which was applied in many states for the amelioration of untoward factory lighting—being now so widened in scope that they may be made applicable to all commercial lighting.

But whether the consumer is induced through education to adopt those measures and make those expenditures in alterations to equipment or wiring calculated to serve his best interests or is enforced so to do through public protective measures, it is self-evident that electric lighting maintain its past or an improved standard of excellence, whatever the means which must be pursued to that end.

For the present, we must not only endeavor to educate others but ourselves also and be honest as practitioners in applying the knowledge thus obtained. This, in lighting, is the whole duty of the whole industry.

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**The Engineer as a Financial Man**

Considerable discussion is current as to how the condition and position of the engineer can be bettered. Unlike the lawyer and the doctor, the engineering profession seldom comes into direct contact with human beings. Though men are dependent upon engineering structures, upon waterworks, power plants, telephones and electric cars, for many of their necessities and conveniences, they are prone to lose sight of the engineer as an indispensable factor in their design, construction and operation. Consequently it behooves the engineer to get into closer touch with the people as well as to broaden his field of activities.

The financial field is one which a number of engineers have entered with success. It is likewise one which offers opportunities for many other engineers who feel the limitations of work of a strictly technical character. The financing of public utilities can well be undertaken by engineers because of their more or less technical character.

The engineer can speak as one with authority concerning public utilities. This inspires confidence, the first requisite in the financial world. The best methods of construction, the probable costs and the possible market are subjects about which the financial man now consults the engineer, who, like, John Alden, would do well to speak for himself.

This speaking for oneself is an art which most engineers have failed to cultivate. This lack of oral expression arises, in part, from a praiseworthy modesty, but in part also, is a deficiency in the engineer's education. It is a rare engineer who is not afraid of the sound of his own voice. Let every engineer, therefore, learn how to talk as well as how to do, for talking moves men's minds mightily.

The engineer should also learn the elements of corporate finance. He should be informed about securities, the varieties of stocks and bonds, their obligations and their privileges. A balance sheet should be as clear to him as a logarithmic equation. There is nothing from which an engineer can profit more than a post-graduate course in such business subjects as these. Financial reading is an important part of every engineer's education.

These suggestions, while of value to every engineer, are particularly essential for observance by the man who would employ his engineering knowledge and ability in the service of the investor. The business of financing public utility and other securities is legitimate and remunerative. The engineer can do much to further advance its standing and, in so doing advance his own fortunes. Meanwhile, also, the general public will be taught to appreciate the need for greater service from the engineer.

# PERSONALS

**W. R. Lyall** of the D. & W. Fuse Company, Providence, R. I., is a recent visitor at San Francisco.

**Geo. C. Campbell,** manager Truckee River General Electric Company, and Mrs. Campbell are spending the holidays at San Francisco.

**A. S. Lindstrom,** of the Thordenson Electric Company of Chicago, has opened a branch office at San Francisco in the Rialto Building.

**Carl E. Heise,** San Francisco manager of the Westinghouse Electric & Mfg. Company, has returned from Los Angeles and San Diego.

**B. J. Klein,** western manager of the Bristol Instrument Company, has decided to open an office at San Francisco in the Rialto Building in the near future.

**E. J. Kingsley,** Southern California representative of the Federal Sign System (Electric), has returned from San Francisco to his headquarters at Los Angeles.

**H. P. Munger** of the Hughes Electric Heating Company, Chicago, has returned to San Francisco after a short business trip to Salt Lake City and the Northwest.

**A. J. Myers,** Pacific Coast manager of the Wagner Electric Company, has returned to San Francisco after a successful business trip throughout Southern California.

**C. C. Hillis,** manager of the Electric Appliance Company at San Francisco, received the sad news this week of the death of his father, Edward Hillis, of Columbus, Ohio.

**S. K. Colby,** assistant general sales manager of the Aluminum Company of America, has just returned to his office at New York after a two months' visit on the Pacific Coast.

**A. S. Armstrong,** sales agent representing R. J. Davis of the Century Company, will visit the towns throughout the Sacramento and San Joaquin Valleys about the first of January.

**Wm. G. Stearns,** formerly of the Portland office of the Standard Underground Cable Company, is now at the San Francisco office of that company as chief salesman in the district.

**Paul A. Shilton,** representing R. J. Davis, Pacific Coast manager of the Century Electric Company in Los Angeles, has returned to this city after an extended trip throughout the Southwest.

**R. E. Bailey,** power salesman in the Salt Lake division of the Utah Power & Light Company, has been transferred to the sales department of the company's general office at headquarters in Salt Lake City.

**W. S. Berry,** sales manager of the Western Electric Company at San Francisco, has returned to San Francisco after visiting their offices at Portland and Seattle, where he is much pleased with the improved conditions.

**M. F. Steel,** representative of the Benjamin Electric Manufacturing Company, has returned to San Francisco after a very successful business trip to the Northwest. He is expecting to leave for Arizona in the near future.

**K. G. Dunn,** vice-president of Hunt, Mirk & Co., has recovered sufficiently from an automobile accident at San Diego last month so that he can be moved to San Francisco, where every prospect indicates an early resumption of activities.

**F. W. Wilson** of the San Francisco office of the Standard Underground Cable Company, will be located after January 1, 1916, at Salt Lake City. The company is opening a suboffice at that point, and Mr. Wilson will be in charge as district sales agent.

**H. S. Wells,** superintendent of residence district sales in the Salt Lake division of the Utah Power & Light Company, has returned to Portland, Oregon, for a couple of weeks, where he was called to testify in a law suit in which the Pacific Power & Light Company, with which he was formerly connected as salesmanager, is involved.

**T. W. Ransom** will give up his position as consulting mechanical engineer to the board of public works of the City and County of San Francisco, on January 1, 1916, and will return to his former practice as a consulting engineer with offices at 1104 Merchants' Exchange Building, San Francisco.

**A. Emery Wishon,** assistant general manager of the San Joaquin Light & Power Corporation of Fresno, Cal., spent a week in Salt Lake City recently. While there he investigated electrical developments in that field, particularly with reference to the application of electricity to cooking and baking. Mr. Wishon expresses himself as favorably impressed with progress which the Utah Power & Light Company has made in the installation of electric ranges in apartment houses and electric bake ovens in restaurants and bakeries. He spent considerable time interviewing their customers and quite generally received unqualifiedly favorable comments.

**Paul M. Lincoln,** whose connection with the Westinghouse Companies in their operating and engineering activities dates back for over 23 years, as of January 1, 1916, becomes associated with the sales organization of the Westinghouse Electric & Manufacturing Company with the title of commercial engineer. Mr. Lincoln is well known in engineering circles through his active work in the American Institute of Electrical Engineers, of which he is a past president. He is a well-known writer on technical subjects, and has also been identified with educational work for some time, filling the chair of professor of electrical engineering of the University of Pittsburgh. Mr. Lincoln was graduated from the Ohio State University in 1892.

**W. D'A. Ryan,** chief of illumination for the Panama-Pacific International Exposition, stopped off in Salt Lake City, December 17, while on his way from San Francisco to Chicago, where he had been called in connection with plans for some special lighting for Christmas. While in Salt Lake City he appeared before the city commission and explained to them details for the special lighting system on Main street, which he designed. The system consists of a special ornamental post designed to fit over and conceal the regular trolley pole. Each post carries three 6.6 amp. inverted luminous arc lamps. The standards will be spaced approximately 100 ft. apart on each side of the street for a distance of 4000 ft. on Main street. The commission, after listening to Mr. Ryan, approved the plans as submitted and instructed the recorder to prepare an advertisement for notice of intention to make the improvement accordingly.

**Bayard W. Mendenhall,** sales superintendent of the Salt Lake division of the Utah Power & Light Company, has tendered his resignation, effective December 31, and will thereafter engage in business for himself. Two years ago Mr. Mendenhall organized the Electric Specialty Company, which makes a line of electrically heated chick and bacteriological incubators, and he will now devote his entire time to the interests of the company. Mr. Mendenhall entered the employ of the Utah Light & Railway Company in the fall of 1905, as power salesman, and has been with that company and its successor continuously since, except for one year spent at Ely, Nevada, as manager of the Ely Light & Power Company. Since May, 1908, he has held the position of commercial agent for the Utah Light & Railway Company and as sales superintendent for its successor, the Utah Power & Light Company. Mr. Mendenhall graduated in electrical engineering from the Massachusetts Institute of Technology of Boston in 1902. The next three years he spent in the organization of Stone & Webster of Boston.

## PIERSON, ROEDING & COMPANY CHANGES.

H. R. Noack, president of Pierson, Roeding & Company, announces the resignation of Thomas Finigan as vice-president of the company. On January 1st Mr. Finigan will take charge of the interests of the American Brake Shoe & Foundry Company as Pacific Coast manager, with offices at 301-303 Call Building, San Francisco. H. S. Whiting of Pittsburgh, has been elected vice-president to succeed Mr. Finigan. Mr. Whiting has already taken up his residence in San Francisco, and is in active charge of his new office.

In line with the new policy of Pierson, Roeding & Company, as published in the December 11th issue of the Journal, two important changes in agencies have occurred.

After five years of successful and satisfactory association with the Electric Storage Battery Company of Philadelphia, it has been decided to discontinue this arrangement, and after January 1st, the Electric Storage Battery Company will be located in their own sales office at 739-745 Rialto Building, in charge of George R. Murphy, until this time manager of Pierson, Roeding & Company's storage battery department.

On January 1st the long standing relations with the R. D. Nuttall Company will also change, and hereafter the Nuttall Company's business will be handled by the Westinghouse Electric & Manufacturing Company at its various offices on the Pacific Coast.

The J. G. Brill Company of Philadelphia, Pa., also announce that their successful and very satisfactory association with Pierson, Roeding & Company has for years postponed having their own offices and their own representatives on the coast. As circumstances point to the present time as being best suited for making the change, it was decided to institute the new procedure December 1st and extend their own sales organization to cover the Pacific Coast territory, with offices at 907 Monadnock Building, San Francisco, under the management of Mr. F. A. Richards, who has had charge of the car and truck department of Messrs. Pierson, Roeding & Company since 1909.

## NINTH ANNUAL REPORT PUBLIC SERVICE COMMISSION OF OREGON.

The Public Service Commission of Oregon in its ninth annual report reviews the work of the past year.

The total number of formal complaints filed during the year 1915 was 130, compared with 141 in 1914. Ninety-one of the new matters were in the railroad division, and 39 were utility matters. New informal railroad complaints were 263 in number, against 345 in 1914, while informal utility complaints increased from 177 in 1914 to 204 in 1915.

Of informal utility matters, 229 were handled, 204 of these being new, 25 pending at date of last report. Informal adjustment was accomplished in 167, 9 were transferred to other docket positions, 5 were discontinued because plaintiffs were disinclined to pursue them further, 13 were dismissed as not well founded and 35 are pending.

Electric rates for light or power were involved in 28 informal utility matters, electric service in 17, gas rates or service in 30, water rates or service in 8, street railway fare or service in 2, telephone rates in 33, telephone service in 61, telegraph rates or service in 2, hazardous wiring conditions in 50. Of the new informal utility matters, 169 were filed by individuals, corporations or associations, and 35 were taken up on the commission's own motion.

Formal utility complaints show 20 dealings with rates and 22 with service, certain of the complaints covering both rates and service. Twenty-nine related to telephone utilities, 4 electric or gas, and 6 water. Twenty-seven formal hearings were held, 34 complaints were closed, and 18 are pending.

Among the important cases disposed of during the year, the following may be mentioned:

City of Bend v. Bend Water, Light & Power Co., Case No. UF-108, involving electric lighting and water rates at Bend; Campbell v. Hood River Gas & Electric Co., Case No. UF-82, electric rates in Hood River and Hood River Valley; La Grande Commercial Club v. Eastern Oregon Light & Power Co., Case No. UF-75, involving lighting rates in numerous cities in the Grande Ronde Valley; In re Western Telephone Co., Case No. UF-142, telephone rates at Woodburn; Tualatin Valley Transportation Association v. Oregon Electric Ry. Co., Case No. UF-290, suburban rates out of Portland: Wright-Dickinson Hotel Co. v. Pacific Telephone & Telegraph Co., Case No. UF-22, physical connection of competing telephone systems; and In re rates, charges and regulations of the Pacific Telephone & Telegraph Co., Case No. UF-117, as to customers' deposits, cancellation charges and other telephone practices.

Hearings have been concluded on the question of the value of the property of the Portland Railway, Light & Power Company. Upon this subject, testimony covering in excess of three thousand pages was received, and 140 separate exhibits were offered. This case is now submitted for decision. Testimony as to the value of the properties of the California-Oregon Power Company has also been taken, but the case is not fully submitted.

The following statement shows the mileage of lines owned and operated of the various electric railroads within Oregon as to June 30, 1915:

| Commercial Roads—Electric. | Mileage Owned. Main Line. | Mileage Owned. Branches and Spurs. | Mileage Operated. Main Line. | Mileage Operated. Branches and Spurs. |
|---|---|---|---|---|
| Kenton Traction Co..... | 2.90 | | 3.00 | |
| Oregon Electric Ry. Co... | 122.30 | 35.02 | 122.42 | 37.49 |
| Portland Ry., Lt. & P. Co. | 76.26 | | 76.26 | |
| Portland & Troutdale El.. | 1.50 | | 1.50 | |
| United Railways Co..... | 18.64 | 11.81 | 18.64 | 12.60 |
| Walla Walla Val. Ry. Co.. | 5.97 | | 5.97 | |
| Willamette Val. Southern. | 31.90 | | 31.90 | |
| Total ..... | 259.47 | 46.83 | 259.69 | 50.09 |

The fixed capital as at June 30, 1915, operating revenue, operating expenses, net operating revenues, uncollectable revenues, taxes paid in Oregon, and operating income or loss, from July 1, 1914 to June 30, 1915, of the various gas, telegraph, telephone, water, and joint utilities, are set out in the following table:

| | Electric Utilities. | Gas Utilities. | Telegraph Utilities. | Telephone Utilities. | Water Utilities. | †Joint Operations. |
|---|---|---|---|---|---|---|
| Fixed capital, June 30, 1915.... | $4,964,941.28 | $12,706,894.76 | 1,109,692.08 | $17,243,636.36 | $3,166,331.72 | $123,889,207.01 |
| Operating revenues..... | 3,965,212.91 | 1,453,242.48 | 175,416.90 | 3,017,213.35 | 350,099.25 | |
| *Operating expenses ..... | 1,677,832.80 | 672,747.13 | 172,236.26 | 2,182,799.60 | 196,266.96 | 243,219.22 |
| Net operating revenue or deficit | 2,287,380.11 | 780,495.35 | 3,180.64 | 834,413.75 | 153,832.29 | |
| Uncollectable operating revenues ..... | 3,531.71 | 7,529.21 | 1,185.30 | 22,987.68 | 820.15 | 31,555.80 |
| Taxes ..... | 39,151.66 | 101,838.30 | 9,262.79 | 161,283.90 | 18,219.81 | 755,016.80 |
| Operating income ..... | 2,244,696.74 | 671,127.84 | | 650,142.17 | 134,792.33 | |
| Operating loss ..... | | | 7,267.45 | | | |

*Operating expenses do not include taxes or interest.

†Covers items of joint utility operations incapable of segregation between states or electric, gas, telephone and water utilities.

The reports of the utilities indicate considerable rebuilding of lines and replacement of equipment, in addition to extensions into new territory.

During the year July 1, 1914, to June 30, 1915, extensions, additions and betterments, as evidenced by the reports of the various utilities, have been made within the state of Oregon as follows: Electric, $953,472; gas, $455,414; telegraph, $19,800; telephone, $1,216,724; water, $84,562; total, $2,729,972.

## LOS ANGELES EDISON CONDEMNATION HEARING.

In accordance with the understanding that "it is not the function of the commission to determine whether the city can by condemnation take a part of a franchise held or exercised by the company and leave the remainder of the franchises in effect," as previously noted in this journal, the California Railroad Commission resumed its hearings of the Los Angeles Edison condemnation proceedings on December 13th, after the city had filed an amended application showing what franchise rights were desired.

The hearings will continue for several weeks. Commissioner Edgerton, representing the commission, is hearing the testimony. The Southern California Edison Company is represented by Attorneys H. H. Trowbridge and Peter F. Dunne and the city by Special Counsel W. B. Mathews, City Attorney Albert Lee Stephens and William B. Himrod.

The just compensation claimed by the company is $22,850,000. The six items comprising this total are: Severance damage, $11,000,000; going concern, $4,500,000; physical property $4,500,000; Los Angeles Station No. 3, $1,000,000; bond discount and expense, $350,000; reconstructing transmission lines, $1,500,000.

Of the foregoing total of $22,850,000, $9,850,000 represents the value of the Los Angeles distributing property and business. This amount would go to the company's bondholders and stockholders.

The balance of the amount claimed as just compensation, $13,000,000 is damage to the rest of the system, which would in no way benefit the company's stockholders or bondholders, but would be held by the trustee for the bondholders, to be drawn upon from time to time to make up loss in earnings, rebuilding property and finally for investment in new properties to provide additional earnings to make up the loss of earnings in Los Angeles city. This damage is caused by the separation of the Los Angeles business from the outside business, resulting in a decrease in efficiency, as the Los Angeles business has its maximum demand in the winter, while the outside business has its maximum demand in the summer. It may be justly termed "amount of the economic waste involved in the present proceedings."

The case for the company was opened by H. H. Trowbridge, who stated that the company owns a large interconnected electric generating transmitting and distributing system, having a considerable number of hydroelectric plants in different parts of Southern California, and several steam plants; that this system was created by the acquisition from time to time of a large number of smaller companies and systems, and by additions and extensions from time to time by the company itself and by its predecessors of interest. "We will show that the system is operated as a unit in its entirety; that the City of Los Angeles is the center of the company's distribution of electric current and that the company derives approximately 45 per cent of its gross and net revenue from its business within the City of Los Angeles; that the company's properties for the generation and transmission of electric current are used partly for supplying Los Angeles and partly for supplying the company's customers outside of Los Angeles; that of its so-called general investment, something upwards of $5,000,000 is required for supplying electric current to this company's consumers within the City of Los Angeles; that upon the severance of the Los Angeles distributing system from the balance of this company's property, this company will be left with this proportion of its properties for the generation and transmission of electric current for which the company will have no use until such time, if that time ever comes, when the maximum demand upon the company's generating system after severance is the same as the demand prior to severance.

"One of our claims for compensation in this case will be the damage which this company will suffer by reason of the severance of its Los Angeles distributing system from the balance of its interconnected unit property. To show this element of damage, we will introduce testimony showing the results to this company and to its business caused by such severance. We will introduce testimony upon this subject from a number of witnesses who will approach the subject from somewhat different angles and will not all arrive at the same result in dollars and cents, but the amount of this severance damage which we will claim as part of our just compensation in this case will be established by these witnesses at sums ranging from ten to twelve millions of dollars.

"A second item of just compensation which we will claim in this case is the value to this company of its business in the City of Los Angeles which will be taken from it in this proceeding. We will introduce testimony from several witnesses as to what is the value to this company of its Los Angeles business. These various witnesses will likewise approach the question of placing a value upon this item of property in somewhat different manners and will arrive at somewhat different results. They will likewise not all give the same name to this element of property. One witness, Prof. Adams, will describe this property as 'the value of the property as organized and used in excess of the investment cost of the property, or the physical value of the physical value of the property.' Other witnesses will refer to this element of property as 'going concern value.' However, they will all mean the same property, viz: the value to this company of its developed and organized business in the City of Los Angeles of which it will be deprived in this proceeding. The value placed by different witnesses upon this element of property will range from $4,619,000 to $4,360,000.

"Another element of compensation which this company will claim in this case will be the value of its physical property in Los Angeles sought to be taken in this proceeding. We will show by testimony in this case that the cost of this physical property, determined by the historical method is $5,320,437.92. We will show the present physical condition of the property and its present value, or, as the term is sometimes used, 'depreciated value.'

"We will also claim as an element of compensation in this case, an amount equal to the discount and expense actually incurred by this company in selling its bonds and securities to secure the funds with which it acquired and constructed this Los Angeles distributing system which will be taken from it. This bond discount and expense will be shown by this company from its books; the amount thereof will be shown to be approximately $350,000.

"We will also claim as an element of compensation in this case the expense which this company will necessarily incur in reconstructing and rebuilding its lines around Los Angeles to continue its service after severance, such rebuilding being made necessary by this company's franchises to occupy the streets of Los Angeles with any part of its electric system being taken or destroyed by this proceeding. The amount of this expense to which this company will be subjected we will show by engineers who have made estimates thereof to be approximately $1,500,000. We will also claim as an element of damage in this case the loss which this company will sustain by reason of being deprived entirely of its use of its Los Angeles Station No. 3. We will show by the testimony of the company's accountants that this Station No. 3 cost $1,267,755.18. that by reason of the taking of this company's property and franchises making it no longer possible to use this station, will have a present existing value to this company of $124,344. The difference between these two amounts less proper and appropriate depreciation, we will claim as our damage in the case of Station No. 3.

### B. F. Pearson on Physical Properties.

Mr. B. F. Pearson, general superintendent of the Southern California Edison Company, was the first witness called by the company.

Mr. Pearson gave a general outline of the company's gen-

erating, transmission and distributing systems, beginning with the power plant located in the City of Los Angeles in 1896, having a capacity of 500 kilowatts, ending with the company's present generating capacity of 86,000 kilowatts, comprising seven hydroelectric stations and three steam plants.

At the present time the company's 75,000-volt transmission system has a total length of 214 miles; 10,000-volt lines, 730 miles; 2200-volt lines 1800 miles. Total number of consumers at the present time, 108,435, giving a connected load of 141,766 horsepower with a peak load for the year 1915 of approximately 56,000 kilowatts, whereas the peak load at the end of the year 1897 was only 220 kilowatts.

All data relative to the development of the company's property was brought up in cross examination, including the effect on the transmission system should all the company's property in the City of Los Angeles be severed.

The answer being, the company could not operate except the eastern division up to the capacity of the hydroelectric stations in San Bernardino county, total 8500 kilowatts. It was also brought out in testimony that had Los Angeles not been considered, the steam plant would have been located on Newport Bay, with transmission line intersecting Santa Ana-Orange, with a terminus at Chino, thus bringing the steam plant to the nearest center of the greatest load districts.

### R. H. Ballard Explains Many Phases.

R. H. Ballard, secretary and assistant general manager of Southern California Edison Company, during his direct examination which covered Tuesday and part of Wednesday, testified to the following:

The present company, Southern California Edison Company, started in Los Angeles in 1896 as the Westside Lighting Company as a small steam plant distributing system.

The company was enlarged and its name changed in 1898 to Edison Electric Company and in 1909 to Southern California Edison Company. In the meantime many properties outside of the city had been purchased and the company's affairs extended generally throughout Southern California.

The principal properties purchased were: Santa Ana Gas & Electric Company, Southern California Power Company, Pasadena Electric Light & Power Company, Redlands Electric Light & Power Company, California Power Company, United Electric, Gas & Power Company, Lytle Creek Power Company.

Large contracts were made to supply power to the two cement plants in Riverside and Colton and in 1907 the company began furnishing service to the Los Angeles Pacific Railway, which is now part of the Pacific Electric system, embracing the lines running to Santa Monica and Hollywood sections.

The gross earnings of the company in 1896 were only $3,333 for the year while the earnings in 1915 for its electric department were $4,427,000.

The increase in kilowatt hour sales during almost the entire period has been much greater than the increase in earnings as rates have been constantly reduced, the average rate in 1915 for the entire system in Southern California being only 40 per cent of the rate in 1905; in other words, a reduction of 50 per cent in ten years.

The maximum load on the company's stations in 1904 was about 10,000 kilowatts, while in 1915 it was nearly 56,000 kilowatts.

Testifying further as to the effect of cutting out the Los Angeles business from the balance of the system, Mr. Ballard showed that the gross earnings would be reduced from $4,400,000 to $2,300,000—a reduction of nearly 50 per cent—and that while it is estimated the maximum load on the stations would be recovered in eight years, in the eighth year 1923 the earnings would still be $700,000 a year less than they were before Los Angeles was taken out of the system, due to decreased efficiency.

Likewise the number of kilowatt hours sold during 1915, over 208,000,000, would be reduced by the loss of the Los Angeles business to 110,000,000. During the next eight years they would increase to 178,000,000, being approximately 30,000,000 kilowatt hours less than before Los Angeles was taken away.

It was shown that the combination of the Los Angeles and outside business was particularly advantageous from the standpoint of efficiency and economy as the maximum demand for current in Los Angeles comes in the winter time while the maximum demand for current outside of Los Angeles comes in the summer time.

The same plants which furnish the large winter demand on Broadway at Christmas time are used in the summer time for pumping water for irrigation in the districts outside of Los Angeles, resulting in a lower cost both inside and outside the city which is reflected in the company's rates to consumers.

In other words, there is a great diversity between the city and the outside.

Referring to rates in the City of Los Angeles, Mr. Ballard showed that in 1905 the maximum rate for residence service was 15c per kilowatt hour; in 1908, the rate was 9c per kilowatt hour—a reduction of 6 cents in three years; in 1911, it was 7c per kilowatt hour, and in 1915, 5½c per kilowatt hour.

Outside of Los Angeles, the rate in the districts served by the largest company purchased by the Edison Company in 1904 was 20c per kilowatt hour, and at the present time it is 7c per kilowatt hour.

He referred to the rates in other cities in the United States, showing the comparison with the 5½c rate in Los Angles city.

D. M. Trott, statistician, took the stand for company and qualified as having had fifteen years' experience in general accounting. He was examined by Mr. Dunne as to cost of property.

Mr. Ballard's cross-examination was taken up by Special Counsel Mathews and continued until late in the afternoon of the 16th, when Dr. Hoxie was placed on the stand by the company.

Dr. Hoxie in his testimony, among other things, produced sixteen charts showing the divisions of load carried by the company in its different districts expressed in kilowatts of demand upon stations; kilowatt hours sold to consumers, based upon a study of each day's record of each of the thirteen districts of the company in the past year.

The first chart showed graphically that were the Los Angeles business taken out of the system, the remaining business would be entirely disarranged by the fact that the center of load would be transferred from Los Angeles to Colton and the cost of furnishing service to all of the outside districts would be increased

Many of the small communities who have accepted the service of the company at the general rates based upon the unit cost of the company operating as a complete, unified system, would be made unprofitable to the company unless compensated for as part of severance damage.

It was shown that by operating all of the districts of the company as one system, the individual maximum demands of each district were at different times, resulting in a maximum load on the company's generating system of 55,880 kilowatts; whereas, if each district of the company were operating separately, the sum of the maximum demands of these districts would have been over 75,000 kilowatts, necessitating an additional investment in generation and transmission property to provide the extra 20,000 kilowatts, representing an added cost of over $4,000,000.

## FUNCTIONS OF MUNICIPAL INSPECTION BUREAUS.

BY ARTHUR KEMPSTON.

*(This paper gives excellent suggestions as to how the electrical inspector can assist the electrical contractor. It was read before a meeting of the California Association of Electrical Inspectors. The author is inspector with the San Francisco Department of Electricity.—The Editor.)*

Inspection of electrical work installed in the premises of its citizens is one of the newer functions of municipal government. It has existed in San Francisco only since 1900. Its beginnings were simple and the effort was at first only to provide an inspector when the owner of property requested an inspection.

Electricity was then considered an exceedingly dangerous thing. A sort of condensed fire, ready at all times to escape its confining wires and burn up the building. Users demanded an expert examination of the installation, ofttimes believing that unless watched, the contractor would "skin the job" in his effort to make a greater profit.

Unfortunately, the same feeling exists today somewhat modified, perhaps. It influences to a considerable extent our vision of just what inspection is.

Inspectors are practical men who have worked at the various branches of the electrical business and they know costs and methods. They can readily see the saving in costs which can be had by lax methods of work or the use of poor material. From the very nature of things, as existing today, the inspector becomes a Sherlock Holmes, always seeking faults and defects. He is not an educator, however, and therein lies the serious error of our present attitude. Because of the continual search for defects and the sleuthing done, an inspector's view is narrowed and his conception of duties contracted until in time he fairly believes that his mission is solely to prevent contractors "beating the game."

It is certainly time to revise our methods of handling the entire problem of electrical inspection. We should abandon the idea of standing between the contractors and the public and substitute in its place a new attitude. We should become an institution disseminating the latest, best and most economical, methods of doing electrical work.

An inspection bureau can enforce standards of work and material through the powers conferred upon it by the municipal government. It can determine what constitutes a satisfactory method of installation; what materials can be used and in what places; it can decree that certain methods of installation may be used only in certain classes of buildings. It can require that contractors be registered for purposes of control. That jobs be reported before any work is started. That installations be left uncovered until inspected. That no electric current be used until a final inspection and certification be made. That fees may be collected for its services.

The possession of these duties and powers make the inspection bureau an ideal institution to meet, recognize and correct the evils evisting in business of installing electric work.

The contractor of today cannot rightly afford to trade on a belief that with good luck he can get by the inspector with poor work. He has too much at stake. The inspection bureau with its powers may revoke the contractor's right to do electrical work and the publication of such revocation would put the derelict contractor, with all his investment, out of business.

While these extreme measures have heretofore been used very little, the time has come when a more radical stand must be taken with regard to poor work. Contractors should be required to supervise their work more closely. At present many contractors make no pretense of visiting their jobs but depend on the inspector to locate faulty work. This is entirely wrong. Contractors should be required to supervise their work and not depend on the inspector acting as a sort of unofficial foreman for each job.

While it has been the practice in some cities to require an examination of wiremen to determine their knowledge of the business, that has never been necessary in San Francisco. The workers are, almost without exception, competent. There is so much keen competition between contractors that none can afford to hire any but excellent mechanics who know the rules and understand their application.

To enforce a high standard of work is therefore a matter entirely between the inspection bureau and the contractors. The worker can and will produce the grade of work directed by his employer.

The general public should be educated to the fact that electrical work contains an actual hazard to life and property. All should be made to realize that only when installed properly by skilled mechanics is the use of electricity safe. That putting in an extra light, heating device or a motor constitutes a distinct danger to the building and its occupants unless it is properly provided for in the wiring of the building.

As in all matters where so many and varied interests are represented, it is necessary to have a final tribunal, whose decisions, reached after consideration of the question in its largest aspect, shall be capable of enforcement. It is in this duty that an inspection bureau can demonstrate its worth and value. The greatest effort should be made of course to procure the safest installation possible. This must not be carried to such an extreme though that the amount of labor required or the cost of material is unreasonably excessive. There is a cost above which property owners will not go for the installation of electrical work and that must not be exceeded. To do so would result in the use of gas or other means to the detriment of the electrical industry.

The successful inspection bureau will hereafter promulgate its rules and requirements after consultation and conference with all the interests involved. After such consideration it will be in a position to expect and receive full support from all parties in the enforcement of rules.

To that end it is necessary after a policy has been determined by the inspection bureau, that it shall be clearly set forth so that all those interested, contractors, wiremen and inspectors, may have an exact and uniform understanding. Thereafter any deviation would necessarily be deliberate and intentional and result in serious consequences to the guilty person.

It is very essential that inspectors, particularly, be familiar with the exact requirements and the reasons therefor; that regardless of their private opinions on any question, all enforcement of rules would be absolutely uniform.

Swift and sure exposure should be given any contractor who deliberately violates the rules or permits it to be done by his employes. Let it be known that there is no room in the business for law-breakers and there will be little of it done.

Finally keep everlastingly busy on publicity, for the general public. Educate the average citizen so that he would telephone the police if he had knowledge of unreported or improper electrical work being done. Look upon it as you would any other violation of law.

If the public will not have poor work because of the danger, your legitimate contractor will have all the work and at a fair price.

Your inspection bureau will no longer be composed of disciples of Sherlock Holmes but of men who, having the opportunity to study the big electrical problems of today, will be able to sit in on their consideration. I am sure it will be much more to our liking.

# NEWS NOTES

## FINANCIAL.

SALT LAKE CITY, UTAH.—The Electric Bond & Share Company is offering an allotment of their 7 per cent cumulative preferred stock of the Utah Power & Light Company to intermountain investors through the Harrold R. Smoot Securities Company of Salt Lake City. The outstanding shares of this stock, amounting to $3,000,000, were recently purchased by the Electric Bond & Share Company from the Utah Securities Corporation. This is the first time any of the securities of the Utah Power & Light Company, except bonds, have been offered locally to the company's patrons, according to Mr. Smoot. He further states that the stock is first preferred, both as to assets and dividends, and the statement of the company for the 12 months ending October 31, 1915, shows that earnings applicable to dividends on the total amount of preferred stock outstanding is more than three times the annual dividend requirements. The Utah Power & Light Company, in addition to the properties operated in its own name, owns all of the capital stock of the Utah Light & Traction Company and all of the stock and bonds of the Western Colorado Power Company, except directors' shares in both companies.

## ILLUMINATION.

WENDELL, IDAHO.—Great Shoshone & Twin Falls Water Power Company has been given a contract to install a new city lighting system.

BAKERSFIELD, CAL.—C. B. Colby has been granted a franchise to lay pipes for the purpose of supplying gas to the inhabitants of Kern county, for light, heat and power.

SEATTLE, WASH.—Bids will be received by the office of the Depot Quartermaster, Fort Keogh, Mont., until January 15th, for furnishing and installing an electric lighting system.

BELLINGHAM, WASH.—The city council has passed a resolution instructing the Puget Sound Traction, Light & Power Company to install some 450 tungsten lights in Bellingham.

SPOKANE, WASH.—The city council has accepted the bid of the Washington Water Power Company for the installation of an ornamental lighting system on Trent avenue, at $27,000.

BOISE, IHADO.—An application has been made by Wm. D. Wilcox of Chicago for permission to construct a gas plant in the city of Idaho Falls, Idaho. Mr. Wilcox plans to construct a plant by June 1, 1916.

RIVERSIDE, CAL.—A new arrangement has been made whereby the installation of the ornamental lighting system on East Side, is taken over from the City Electric Supply by the City Electric Light Department.

SANTA BARBARA, CAL.—The Santa Barbara branch of the Southern California Edison Gas & Electric Company is planning on duplicating the present gas plant and expects to expend $50,000 late in 1916 or 1917.

MOSCOW, IDAHO.—The county board has granted a franchise to A. V. Dunkle of Kendrick to utilize the public highways for the purpose of installing an electric light system and transmission lines between Kendrick and Troy.

SACRAMENTO, CAL.—C. W. McKillip, district manager of the Pacific Gas & Electric Company, announced that the company has authorized the expenditure of $30,000 in Oak Park, to be used in laying gas pipe ends in that section of the city.

PASADENA, CAL.—Two bids for an automatic motor operated induction feeder regulator for the municipal lighting department, from the General Electric Company, $1350, and the Westinghouse Electric Company, $1400, were opened and referred to the city commission.

WEISER, IDAHO.—A certificate of public convenience has been issued to the Weiser Oil & Gas Company authorizing it to proceed to construct a gas plant and mains to supply this city with natural gas from a well near town. The plant must be ready for operation in 18 months.

LOS ANGELES, CAL.—The city council has adopted a resolution authorizing the board of public works to enter contract with the Los Angeles Gas & Electric Company for furnishing current and maintaining arc lights for street lighting in the city, and with the Pacific Light & Power Corporation, for lighting streets in Hollywood district.

RICHLAND, ORE.—It is stated that three different firms have been figuring on a franchise for electric lights and power in Richland. The Oxbow people are figuring on the cost of running their wires to Cornucopia, Pine and Eagle Valleys. A Portland concern is negotiating for a power site near Richland and local parties have a plan in mind whereby electricity for light and power can be generated in conjunction with a water system for Richland and New Bridge.

HOOD RIVER, ORE.—Flood water of the Hood River on December 21 flooded portions of the plant of the Oregon Lumber Company, at Dee, swept away a section of the wagon bridge connecting the city with the East Side trunk road, destroyed a $2500 fish ladder over the dam of the Pacific Power & Light Company, a short distance up the stream; temporarily put the plants of the Hood River Gas & Electric Company out of business and threatened the bridge of the Mount Hood Railway line.

## TRANSMISSION.

NAPA, CAL.—The board of supervisors has adopted an ordinance granting to John N. Mount permission to erect and operate in Napa county towers and other superstructures for conducting electricity.

WINNEMUCCA, NEV.—The Winnemucca Mountain Mining Company is preparing to install a power line from the plant of the Winnemucca Water & Light Company to transmit electric power to the pumping station and thence to the mill, which is also to be run by electricity.

ALBUQUERQUE, N. M.—A. G. Hilberg says eastern capitalists whom he represents have decided to back the White Canyon project. This was stated before a meeting of citizens at the Commercial Club. The idea is to generate power cheaper than present plants can make it.

EUREKA, CAL.—In order that power may be supplied to the Marysville Dredging Company which is to engage in a big gold dredging project, 2½ miles west of Junction City, the Western States Gas & Electric Company's hydroelectric plant which supplies electric power to this city, is to be greatly increased in capacity.

PROSSER, WASH.—The preliminary survey for a dam on the Yakima River for a municipal power plant has been made. Estimates of the cost of the system and the petition will be presented to the city council in January. Should the council approve the plans and call a special election to vote on the bonds the entire plant would likely be built next summer.

## TRANSPORTATION.

BERKELEY, CAL.—The city council has refused the petition of the San Francisco-Oakland Terminal Railways to be allowed to abandon that portion of the traction line on Dwight way, east of Shattuck avenue.

FRESNO, CAL.—J. J. Mahoney has announced that the Fresno Interurban Railway Company would extend its line to

Clovis after the first of the year with a spur track to Melvin and would also build a boulevard from Fresno avenue to Clovis along private right of way.

BOISE, IDAHO.—A preliminary survey is being made by the Twin Falls Electric Railroad Company of the route to Castleford with a view of constructing the line as early as possible. The line will extend through Clover City. The road will be about 20 miles long.

OAKLAND, CAL.—Negotiations which may mean the extension of the Key System's Twenty-second street line into the Piedmont hills, opening up the entire region to direct connection with the city, are being made between local capitalists and property owners and the San Francisco-Oakland Terminal Railways. It is anticipated that in a short time a definite arrangement will be completed.

## TELEPHONE AND TELEGRAPH.

CHEHALIS, WASH.—The telephone business at Toledo has been sold to George Blair, to take possession January 1st.

HAVRE, MONT.—Hingham Telephone Company, incorporated for $10,000, will install and operate a telephone system in Hingham.

NORTH YAKIMA, WASH.—Joe Herke of lower Tampico has purchased the Tampico telephone property and system, estimated to be worth $4000. It is understood that Mr. Herke intends to make repairs in the system and will continue to operate.

SAN FRANCISCO, CAL.—Two telephone and telegraph cables between the Ferry Building and Goat Island, containing fifty wires, were severed a few days ago. It is supposed it was caused by some vessel dragging its anchor in the heavy ebb tide that was running.

PRESCOTT, ARIZ.—District Manager R. M. Buehler of the Mountain States Telephone & Telegraph Company, states that work to the amount of $40,000 will be done on the Prescott telephone system. New Poles and wires will be put in place and it is expected that work will begin in the near future.

## WATERWORKS.

RIDGEFIELD, WASH.—The city is receiving bids for the construction of the water system for which $11,000 in bonds were voted, bids to be opened January 5th.

OLYMPIA, WASH.—Bonds in the sum of $110,000 have been voted by the citizens of Olympia to take over and operate as a municipal proposition the plant of the local water company.

FALLS CITY, ORE.—The water board has been instructed by the city council to begin work on the water extension to Teal Creek as the work must begin within a certain time to hold their rights.

GOLDFIELD, NEV.—The citizens of Lovelock will soon decide whether they wish to bond the town by special election for the sum of $90,000 in order to build a water system, or continue to operate under the present system.

COLVILLE, WASH.—An estimate of the city water by D. H. Sawyer, hydraulic engineer, indicates that there is not sufficient water for proper fire protection, and the authorities have under consideration three available water heads for a new system.

MILWAUKEE, ORE.—The contract for furnishing material and construction for the distribution system of the Milwaukee municipal water plant according to plans prepared by City Engineer Morris has been awarded to Giebisch & Joplin at $22,542.

RIVERSIDE, CAL.—Plans are made to get a water supply system installed and engineers are at work. A well is being sunk near Gage Canal, and two reservoirs are to be built, one on the first knoll, above the main buildings, for supplemental irrigation purposes, the other for domestic use. The main building is to cost $100,000.

BANDON, ORE.—Bids for the bonds to refund the $40,000 in outstanding warrants and to renew the water system within the city have been accepted by the council. The Western Bond & Mortgage Company of Portland purchased the bonds.

SANTA MONICA, CAL.—By a margin of 33 votes the electors of Santa Monica refused to bond themselves to the extent of $712,000 for the purpose of buying out the three water companies and organizing a municipal water system.

## TRADE NOTES.

On January 1, 1916, the name Holophane Works of General Electric Company was changed to Ivanhoe-Regent Works of General Electric Company. This change was made necessary by the expiration, on that date of the contract through which the General Electric Company possessed exclusive right to manufacture and sell Holophane prismatic glass. The General Electric Company will continue to manufacture and sell Regent glass and Ivanhoe metal reflectors; and although its right to handle Holophane prismatic is no longer an exclusive one, it will continue to furnish this line also. In its organization the Ivanhoe-Regent Works of General Electric Company is in every respect the same as that hitherto known by the Holophane Works of General Electric Company.

A most unusual and acceptable holiday gift has just been made by the Southern Sierras Power Company in the form of a life insurance policy upon the life of each of its several hundred employes—each policy being for the sum of one thousand dollars. These policies are issued by the Equitable Life Assurance Society of the United States, and the premium upon each policy will be paid and the policies kept in force at the sole expense of the power company and without cost to the employe. Coincident with the announcement of this generous gift. The Southern Sierras Power Company and its associate companies operating in California and Nevada, have established a plan by which the employes of these companies will, from the beginning of the new year, maintain a hospital or sick benefit fund for the care and treatment of employes who from time to time shall suffer illness or personal injury not sustained by accident arising out of and in the course of their employment. This means that the benefits to be had by employes from the use of this fund are entirely separate from the benefits conferred by the Workman's Insurance and Safety Act of California and the Nevada Industrial Insurance Act. To maintain this fund a nominal monthly contribution is made by each employe, (depending upon the amount of monthly salary and in no case exceeding one dollar), and this contribution entitles each regular employe to receive medical and surgical treatment, and hospital care if necessary, including medicines (other than patent or proprietary), in case of sickness or injury; the amount in each case being limited to two hundred and fifty dollars. The creation of this fund is for the sole use and benefit of the employes, and the custody and administration of the fund will be entirely separate from the business of the company, but the company will co-operate by supplying its facilities and the services of its officers to look after the general details of administration.

The board of education of Salt Lake City, Utah, has placed an order with the Utah Power & Light Company for electrical equipment for the domestic science departments of three of the city's graded public schools. The equipment of these departments will be exclusively electric and will consist of 24 Hughes No. 10 hot-plates provided with three heat control and 1100 watt units and two No. 74 General Electric Company's electric ovens for each school. The order includes a special ten gallon soup boiler, the walls of which are insulated and which is heated by a 4½ kw. immersion type heater. This kettle will be used in preparing soup for the light lunch which is served to pupils wishing it and for which a nominal charge is made. If this kettle proves to be entirely successful it is expected by the company that many more will be used in the schools for the same purposes.